The FOUNDRY

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Cast Art Objects to Beautify the Home

CANDLES probably were used first in the temples of the ancients, and likewise, the first candlesticks were fashioned for ecclesiastical purposes. Early history indicates that candlesticks did not find use for domestic purposes until about the middle ages and since the domestic types were very simple, the greatest interest lies with those made for the church. It was not until the eleventh or twelfth century that ornamental candlesticks began to appear. Following a period when the most fantastic designs of animals, angels, cupids and other forms held sway, the tendency has been toward great simplicity. The accompanying illustration, showing a modern console set, includes a pair of beautiful cast bronze candlesticks, adornments for the home that attain distinction by their individuality. The candles are held aloft by figures while the bowl is supported by four nymphs. Beautification of the home is but one of the many services to civilization constantly rendered by the foundry industry.

Courtesy Sterling & Welch Co., Cleveland.

Bronze Art Objects Give Both Grace and Beauty to the Home

Find Where Castings Can Be Sold

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Washing Machine and

By Edwin Bremer

LABOR-SAVING devices in the home are so prevalent that it hardly can be believed they were considered luxuries not so long ago. The average male, due probably to the urge of a superiority complex, is wont to regard the duties of a housewife as a trifling pastime—things that could be accomplished in an hour's work if efficiency methods were applied. However, when housecleaning time arrives the stronger sex discover a multitude of duties away from home that prevent them from participating, physically at least, in that orgy of springtime so necessary to the well-being of every home.

Two devices, which have done much to relieve the housewife of drudgery, are the washing machine and its companion, the ironer. The original washing machines were operated by hand, and while requiring considerable effort in operation, saved many hours of toil over tubs of steaming suds, and backbreaking work of rubbing each garment on the washboard. Later, water operated pistons were applied to supply power for operating the household washing machines, and then with the development of cheaper electric power and electric devices, electric motors were employed as the driving force.

With the advent of the electric motor came the power operated wringer which became an integral part of each machine, and now many washing machines employ a perforated basket which removes excess water from the clothes by centrifugal force. Gas heated, electrically driven and electrically heated and driven ironing machines for smoothing flat work, and other garments which can be handled on such machines,

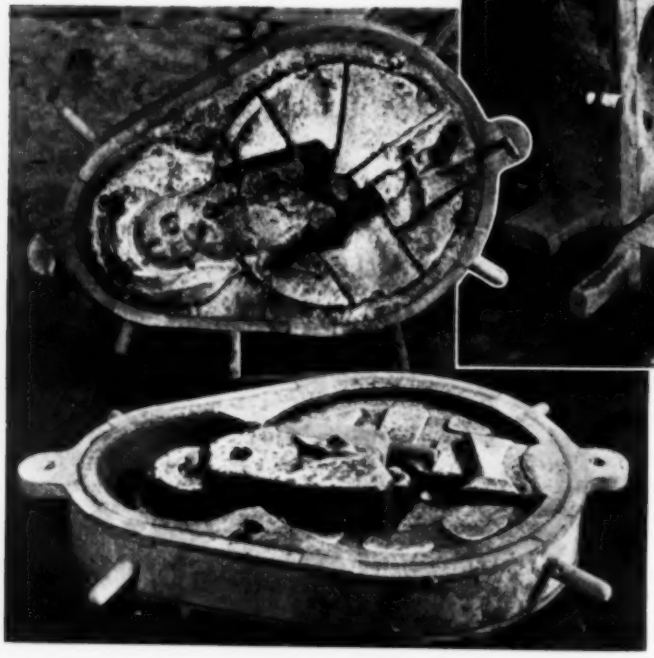


Fig. 1—(Left)—Cope and Drag Molds for a Tub Type Washing Machine. Fig. 2—(Above)—Large Ironer Shoes Are Molded in Wooden Flasks

enjoy an enormous popularity in the household.

It is estimated that about 870,000 electric washing machines were produced in 1929, which is a gain of more than 12 per cent over the production for 1927 reported by the American

Ironer Parts Are

Specialty of Midwestern Foundry

Washing Machine Manufacturers' association as 775,661 machines. Thus it can be seen that there is an increasing demand for that type of equipment. However, 1929 was an unusual year, and the increase for the next few ensuing years hardly can be expected to attain such proportions.

The Electric Household Utilities Corp., located at Cicero, Ill., a suburb of Chicago, is one of the leading manufacturers of electric washing machines and ironers. The firm was organized as the Hurley Machine Co. in 1906, and in 1926 changed its name to that used at present. For a number of years the company operated a foundry at Waukegan, Ill., but increasing demands for its products, and other considerations, pointed to the advisability of constructing a larger foundry of modern design. In July, 1929, the firm began the construction of a foundry at Cicero, Ill., near its manufacturing plant and it was completed several months later. The foundry building is approximately 200 feet wide and 225 feet long, with a wing about 50 feet wide and 100 feet long, which forms a continuation of one side of the building. The front of the building facing on the street is devoted to a cleaning room about 40 x 150 feet, a vestibule or entrance 25 x 40 feet, and an office 25 x 40 feet. A core room 40 x 150 feet, and the cupola room 40 x 50 feet, extend across the back of the building. The wing which extends directly behind the cupola room contains storage bins for pig iron, scrap, coke,

Fig. 4—Eight Drain Cocks Are Made in One Flask

Fig. 3—A General View of the Foundry Molding Floors Showing Several Types of Flasks

etc., and is spanned longitudinally by a heavy I-beam monorail carrying a bucket-type cupola charger supplied by the Chisholm-Moore Hoist Corp., Tonawanda, N. Y.

Gray iron is melted in a cupola and the heat is run off in the afternoon, approximately 25 tons of iron being melted during the 3-hour run. Air for the cupola is supplied by a centrifugal blower equipped with an automatic air-controlling device both manufactured by the General Electric Co., Schenectady, N. Y. The cupola is located outside and close to the wall of the foundry proper, and the spout projects through the wall. The blower and its controlling devices are located approximately on the level of the charging floor in the cupola room, but in a separate chamber.

Make Aluminum Castings

A small quantity of aluminum castings also is made in the foundry, and the metal is melted in three gas-fired, iron pot type furnaces. The furnaces are located diagonally across from the cupola, and along the wall separating the cleaning room from the foundry. That part of the foundry adjacent to the aluminum melting furnaces is devoted to the production of aluminum castings.

A view of the core room which adjoins the cupola room is shown in Fig. 6. Sand for the cores is mixed with cereal binders in a batch-type, sand mulling machine supplied by the National Engineering Co., Chicago. The cores are baked in a 3-compartment, gas-fired oven manufactured by Young Bros., Detroit. Cores are made on the bench and with a hand-jolt, rollover core machine made by the Champion Foundry & Machine Co., Chicago. The core machine is shown in the foreground in Fig. 6.

Fig. 3 is a general view of the foundry and shows some of the special types of flasks used for the molds. Designing the flask for the pattern reduces the quantity of sand necessary, and consequently the weight of the filled flask as compared with the regular square, round, or rectangular flask.

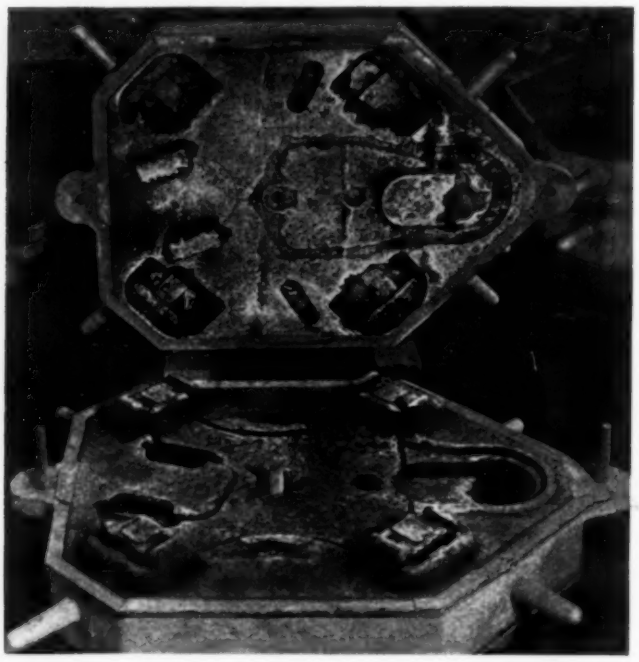


Fig. 5—Flasks Are Designed for the Pattern Which Reduces the Quantity of Sand Necessary for a Mold

The heavier castings are made in the special flasks and the lighter types in snap and taper flasks. Three gangways, extending the full length of the foundry, divide it into sectors. Two of the gangways are approximately 40 feet from the two sidewalls, and the third is about 80 feet from the sidewall shown at the right in Fig. 3. That arrangement of gangways gives three sectors 40 feet wide, and one double sector 80 feet wide, which is worked from the gangways on either side.

Descriptions of molding methods usually are of interest, for while the principles employed are the same from shop to shop, slight variations in pattern mounting, methods of gating, ramming, etc., suggest ideas that may be adapted for the production of similar and other types of castings. For example Fig. 4 shows the cope and drag molds with the cores for producing eight elbow shaped drain cocks for washing machines. The patterns are mounted in two clusters or groups of four each. Each core produces two cocks, the metal stop-off between the two being established by the large circular core print in the center, and the core prints at the ends.

Operates Two Machines

The molds are produced at the rate of approximately 55 per day by one man operating two molding machines for producing drags and copes. The drags are made on a hand-jolt rollover machine, and the copes on a stripper machine. The molder also sets his own cores. As may be observed from the cope shown in Fig. 4, two sprues are used, one for each of the two groups of cavities. The sprues lead into cross channels or runners which are cut into the cavities on either side just along the sides of the core print.

A light, intricate piece of work is shown in Fig. 7. The molds are the cope and drag for an aluminum housing for the gears which drive a table type ironer. Five cores are required to form the interior. The body core is in two pieces, and the other three are composed of the two which project vertically, and one, a cylindrical core, which projects at an angle from one of the body cores. Due to the heavier metal section and the thin body of sand at points marked *A* and *B*, a chill and nails are employed. The chill, which is in the form of half a ring, is placed at *A* in the drag, and nails are used at point *B* in the cope to support the thin body of sand, and also to promote more uniform cooling at that point.

The molds are made by hand at the rate of approximately 30 a day; the molder setting his own cores. A loose

Fig. 6—Cores Are Made on the Bench and on Machines

pattern in one piece with a follow board is used to make the molds. The follow board is supported on a substantial cradle constructed of wood which prevents the pattern from dropping through the board too far. The drag flask is placed in position, and the chill is set in its proper place. A thin layer of sand is riddled on the face of the pattern, and some backing sand shoveled in. The sand is rammed, more sand is put in, and the process continued until the flask is filled. Excess sand is removed with a strike, a little loose sand thrown on, and a bottom board is rubbed into place.

Mold, pattern and follow board are rolled over on the bottom board which now is supported on the cradle. The follow board is removed carefully so as not to disturb the pattern, and the face of the drag is dusted with parting compound. The cope flask is put into position and as in the case of the drag, a thin layer of sand is riddled upon the face of the pattern. Backing sand is shoveled in and rammed as described for the drag. After striking off the excess sand, the molder carefully lifts the cope off and sets it to one side.

Sprue Cutter Is Used

The sprue opening is made with a sprue cutter, and the portion marked *B* is nailed carefully for reasons that have been given previously. The various cores then are placed in position in a regular sequence beginning with the large body core at the left in Fig. 7. It is followed by the other body core into which the cylindrical core projecting back at angle previously has been inserted. Then the remaining circular cores, which extend vertically are placed in position. The mold is closed, carried to its place on the floor, and the snap flasks removed.

Since many molding operations involve considerable muscular fatigue to the molders over a day's operation in lifting and carrying the molds from the bench or machines to the pouring floor, any saving in weight aids considerably in lessening of that fatigue. Fig. 5 shows a method that is employed successfully in repetition molding, consisting in the use of specially designed flasks which conform to the shape of the pattern. That method allows the employment of the minimum quantity of sand for the molds. While at first it appears that the reduction of weight would not be great, calculations show that a rectangular, cast iron flask 5 x 18 x 30 filled with sand will weigh about 202 pounds. With the corners cut off similar to the arrangement in Fig. 5, the weight will be 173.6 pounds approximately, or a saving of 14 per cent in weight.

Two general types of household washing machines have attained great popularity. One is the cylinder type in which the clothes are placed in a perforated cylinder which makes a half revolution and reverses in a horizontal plane in the tub proper. The other is the tub type in which the tub is vertical and the clothes are agitated by a dolly which makes a half revolution and reverses, cups which move up and down, etc. Since the general arrangement of the two types of machines differ, the cast bases which support the tubs and mechanisms also differ in form.

Fig. 5 shows the cope and drag for a base on a cylinder type machine. The metal section of the casting is light, and the casting contains several bosses. A rib around the exterior edge of the casting adds stiffness and strength. Only two small cylindrical cores are used to form holes in the face of the casting. Sprue and riser are located on opposite sides of the

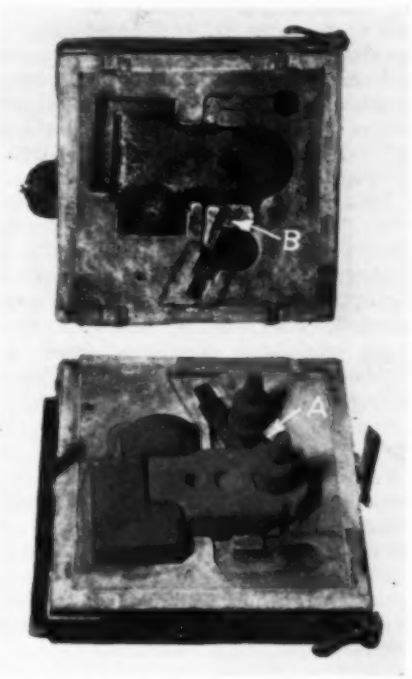


Fig. 7—Aluminum Housing Has Thin Section

cavity at the concave sections. Wide, thin, flat runners cut into the cavity at two points feed molten metal to the casting. Copes and drags are made on separate molding machines supplied by the Champion Foundry & Machine Co., Chicago. The drag molds are made on a rollover machine, and the copes are produced on a stripper machine. The molds are rammed by hand, and two men produce about 75 per day.

Household ironing machines vary considerably in size from the table type and those that attach in place of the wringer on the washing machine, to those that will take the full width of a table cloth. The small ironers have an effective ironing surface of approximately 24 inches while the large ones have 44 inches or nearly twice that of the smaller machines. Fig. 2 shows the cope and drag for an ironer shoe used on the large machines. The shoe is 44 inches long, and the under side, which is curved to fit the feeding roll, is machined and polished before being installed in the ironer. Hence, the face of the casting must be straight and true longitudinally, and free from any surface defects.

The casting is made with the face to be machined in the drag. The rib extending lengthwise along the back contains 20 holes about an inch in diameter and spaced about an inch apart. Between each pair of holes, short ribs, perpendicular to and near the main rib, act as stiffeners, and as heat deflectors when the ironer is being operated. The location of the short ribs may be noted by examining the cope shown in Fig. 2. Due to the position of the holes in the longitudinal rib, they are formed by cores. Consequently, a part of the top of the pattern forms a core print into which the cores later are set.

In molding, the pattern is placed face down upon a bottom board. A wooden flask is centered over the pattern, and a wooden block about 1½ inches square and 12 inches long, which forms part of the runner, is located in its proper position. A layer of sand is riddled over the face of the pattern, some backing sand is shoveled in and carefully tucked around the bars. The sand is peened along the sides of the flask and then rammed. More sand is shoveled in, peened and rammed, and the process continued until the flask is full. The excess sand is removed with a strike, a bottom board rubbed into place and clamped. Then the whole is rolled over.

Parting Line Formed

The clamps are removed and the board, which now is on top, is taken off exposing the face of the mold and the pattern. Since the two arms forming either end of the pattern contain core prints for the cores marked *C* in Fig. 2, a sloping parting line must be made on either end of the pattern. Hence, sand is removed from the cope at those points forming depressions which extend from the top of the pattern almost to the edge of the flask at an angle of approximately 45 degrees. After the sand is cut away to the proper point, the face is slicked to obtain a firm, smooth surface.

Then parting compound is dusted over the face of the mold and the pattern. The drag flask is adjusted over the pins of the cope, and the set gate is put into place. The set gate contains a block which fits into the depression left in the cope by the runner block previously mentioned. A layer of sand is riddled over the face of the pattern and mold, and some backing sand is shoveled in. The sand is rammed and the process continued until the sand is within about 1½ inches from the top of the cope flask. Then two round rods about ½-inch in diameter and somewhat longer than the pattern are placed in the sand. The process of filling the flask is continued until it is full and has been rammed properly.

After striking off the excess sand, a little loose sand is scattered over the face of the flask, and a bottom board rubbed into place. The boards and flasks are clamped together, and rolled over. The clamps and the top board are removed, and the cope lifted off carefully and placed to one side. With the pattern resting in the drag, the molder carefully cuts away the sand along the parting line on either side, similar to that at the point marked *D* in Fig. 6, until the rods are exposed, and then pulls them out. The passages left by the rods form vents which carry away steam and gases.

The pattern is removed from the drag as is the set gate. Then the face of the drag is finished. The molder turns to the cope and with a sprue cutter cuts three holes in the depression left by the runner block. One of the holes is in the center and the other two are at either end of the depression. The hole in the middle acts as the pouring sprue while the other two form skimming risers. The core forming the short, vertical ribs and the holes in the main, longitudinal rib now is put in position. The core is in four sections, and each section is fastened into place by a rod which extends through the cope.

Mold Is Well Vented

The rod has a hook at either end, one engaging a stiffening rod through the core, and the other extending through the cope to supply a means to wedge the core into place. After the cores are fastened, the molder passes a heavy vent rod through the cope at the points just above the pockets that he previously made in the drag. That is done to insure a good vent to the atmosphere for the steam and gases which are formed in the center of the drag. The cope is replaced, the two parts clamped together, and the mold is ready to be poured. One man makes about 10 of those molds a day.

Fig. 1 shows the cope and drag for a washing machine base which forms the support for the tub and for the centrifugal dryer which spins on a vertical axis. As in the instance of the other washing machine base, special flasks also are used. As may be observed from inspection of Fig. 1, the parting line is quite irregular, and the metal section is light. Ribs around the exterior edge of the casting, and at other points reinforce the casting.

A gate with a double sprue near the large end of the flask serves as a self-skimming pouring gate. It feeds into two wings of the casting cavity through a curved wide flat runner. A single riser at the opposite end of the cavity is connected to two points by a similar wide, flat runner. The copes are made on a stripping molding machine, and the drags are made on a rollover molding machine, both supplied by the Champion Foundry & Machine Co., Chicago. Two men make about 60 molds a day.

Institute Develops Sales Helps

The Gray Iron Institute Inc., Terminal Tower building, Cleveland, recently developed an exceedingly valuable set of sales helps designed primarily for use by its members. As pointed out by Arthur J. Tuscany, manager, the sales helps, which are contained in the folder, should assist individual members of the institute in realizing a larger profit in the sale of gray iron castings and products made from gray iron and also should enable foundries to improve their service to buyers.

The first part of the work is devoted to reprints of several articles dealing with the selling of castings which have appeared in THE FOUNDRY. Following this is a long list of articles made wholly or in part of gray iron castings. Folders entitled, "Progress in Gray Iron Castings," "Pointing the Way to Better Castings," "Standard Sales Agreement and Trade Customs in the Gray Iron Industry," and a number of consumer or merchandising bulletins are included. Samples of the standard sales contracts, developed from the standard sales agreement and trade customs also are shown.

Other information included in the folder consists of a nontechnical address for general presentation entitled, "The Romance of Gray Iron," samples of publicity, of value to the gray iron industry, which has been obtained in business and technical magazines and newspapers, and several papers outlining important features of gray iron castings.

Additional sales helps and other material to be included in the folder will be prepared by the Institute from time to time.

A. F. A. Directors Hold Annual Meeting

The annual meeting of the board of directors of the American Foundrymen's association was held July 9 at the Royal York hotel, Toronto, Ont. N. K. B. Patch, Lumen Bearing Co., Buffalo, the retiring president of the A. F. A., opened the meeting, which was attended by some 20 members of the board.

After the report of the association for the past year had been presented, President Patch turned the meeting over to President-elect E. H. Ballard, superintendent of the foundries and pattern shop, General Electric Co., West Lynn, Mass. The board of directors then was organized for the 1931-32 term.

In addition to President Ballard, officers of the A. F. A. for the current year are as follows: Vice president, T. H. Hammond, president, Whiting Corp., Harvey, Ill.; and executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago.

Members of the executive committee, who will serve during the 1931-32 period are as follows: Chairman, N. K. B. Patch, Lumen Bearing Co., Buffalo; Dan M. Avey, THE FOUNDRY, Cleveland; Frank J. Lanahan, Fort Pitt Malleable Iron Co., Pittsburgh, and Fred L. Wolf, Ohio Brass Co., Mansfield, O.

The board appointed a committee to select the city at which the 1932 annual meeting of the A. F. A. will be held.

Establish Center for Foundry Research

To offer to consumers of cast iron the assistance of a complete technical reference library and information bureau and the use of a completely equipped research laboratory, a Center of Foundry Research has been established in France through the co-operation of Hauts Fourneaux de Saulnes. The organization will operate under the general direction of Leon Guillet, director of the Ecole Centrale des Arts et Manufactures, France's leading engineering school.

Operation of the research center will be supervised by August Le Thomas, well known for his studies of cast iron, foundry practice and metallography. He will be assisted by a staff of experienced engineers.

The library and information bureau are located at 18, Rue La Boetie, Paris. Research work will be carried out in the laboratories of the Hauts Fourneaux de Saulnes at Saulnes.

Hold July Outing

July outing of the New England Foundrymen's association was held at Wampanoag Motor club, Taunton, Mass., on July 8. The invitation for the meeting was extended by the Taunton members of the association, and the details and entire arrangements were undertaken by that group.

The secretary, Fred F. Stockwell, reported the death of B. M. Shaw, Walker-Pratt Mfg. Co., Watertown, Mass., and a committee consisting of Joseph L. Anthony, Glenwood Range Co., Taunton, Mass., C. A. Wyatt, Debevoise-Anderson Co., Boston, and Robert C. Bird, Barbour-Stockwell Co., Cambridge, Mass., was appointed to draft a suitable set of resolutions.

After an enjoyable dinner, special entertainment was provided.

Harold H. Clark, for 30 years connected with Link-Belt Co., and during the last 11 serving as vice president and assistant secretary, Pacific coast division, has retired. Ralph M. Hoffman, for the past 8 years, manager of the Seattle office of the company, has been appointed to succeed Mr. Clark.

John Howe Hall

Exposes the

LURE OF ALLOYS

FROM the previous discussion presented in the July 15 issue of THE FOUNDRY it should be quite plain that if a foundry is to engage on any scale in the manufacture of alloy steels and is not to be involved in constant controversy with customers who have been given metal utterly unsuited to their requirements, there must be some one in the organization with real knowledge of alloy steels, their properties, their limitations and their uses. That man's duty is to see that the right steels are selected for the different jobs that come up, that laboratory, shop, and service trials are planned and carried out when new classes of difficult service requirements are presented for solution, and that in recommending steels to customers, promises are kept within the bounds of probability, to avoid disastrous claims for nonfulfillment of guarantees. Such a man must have not only a technical education and training, but imagination, a number of years of practical experience, and, above all, that indispensable characteristic, good judgment, if he is to really serve the best interests of his employers and his customers. Men who can measure up to those requirements are not encountered every day, and command a respectable salary, which is one item in the cost of the manufacture of alloy steels on a safe and sane basis.

High Grade Men Employed

However, it should not be taken for granted that the employing of a high-grade metallurgist, or a superintendent with technical knowledge and experience, will immediately make it possible for a shop to turn from carbon steel to alloy steel manufacture. Higher grade men must be employed throughout the organization, or the existing personnel must be trained in the more difficult art of producing alloy steels. Melters and helpers in the melting shop, who have had experience only with carbon steels, almost have to learn their business all over again, for it is a far different matter to melt up alloy steel scrap, and to add expensive alloys to steel without undue loss, than to deal only with carbon, silicon, manganese, sulphur and phosphorus. To produce alloy steels, especially the highly alloyed types that are thoroughly deoxidized so that they will set quietly in the molds and be free from pin holes and other defects, is a more difficult task than to produce satisfactory carbon steel. The proper temperature at which to pour alloy steels has to be learned by experience, and varies from one type to another. There also are other respects in which alloy steel making practice differs from the making of plain carbon steel.

More Experience Necessary

In the foundry proper, where molds are made and poured, and where money is made or lost, alloy steel making calls for more experienced and able men than usually are found in a shop making carbon steels. Facing and backing sand mixtures have to be varied to suit the requirements of different alloy steels, many of which do not pour and run like carbon steel; heading and gating practice usually is different, especially in the case of the highly alloyed class; the care with which castings have to be handled after pouring, to prevent tears, as by loosening up the sand in cope and drag, providing readily collapsible cores, etc., is greater, and many alloy castings have to be taken hot from the molds and transferred at once to the heat treatment furnaces if they are to be kept intact. The man in charge of the foundry has to know all these things, and as he cannot be everywhere at once, his men have to be familiar with them also, so that in general a higher grade force is required than is usual in a carbon steel foundry.

As most alloy steels require heat treatment to bring out their best properties, annealing and heat treating have to be supervised more carefully in alloy steel foundries, necessitating the employment or the training of a good heat treatment staff.

Last but not least, some of the alloy steels are unmachinable commercially, and are shipped to customers as a finished article. In those cases the cleaning and grinding room staff and the inspectors are not only numerous, but have to be skilled men who understand the customer's requirements, and know what is needed in the way of finish and tolerance. This staff simply does not exist in many carbon steel foundries, but is an absolute necessity in alloy steel plants, such, for instance, as those making 12 per cent manganese steel.

In small plants the superintendent or manager must know when patterns or blueprints come in whether the casting can or cannot be made in the alloy steel desired. For in an astonishing number of cases jobs are brought to the alloy steelmaker that simply cannot be executed without changes in the design. In small shops, the alterations are made in the patterns at the superintendent's direction, but where a considerable tonnage is produced, it would require too much of his time to attend to such details. In that case a larger or smaller staff of engineers and draftsmen is employed to relieve the boss of this routine, bringing only the important cases to his notice. Naturally, the expense of maintaining this engineering staff cuts a considerable figure in the cost per ton of the product.

The Cost Goes Up

As may be imagined, not only is such an organization more expensive to maintain than the relatively less skillful men employed in the manufacture of carbon steel castings, but the training of the staff in the first place is a costly matter. Men are tried for one place and found unfitted for it, transferred to another post, and possibly finally dropped, with a complete loss of the expense of training them. Green men make mistakes that result in lost castings. Production is decreased due to the necessity of teaching the men new methods and new precautions they must take in their daily work, and in general a period of a year or more of expensive training has to be gone through before the organization can function as a properly efficient body of men. Let it not be thought for a minute that this is mere theoretical stuff, "full of sound and fury, signifying nothing"—it is hard cold fact, as anyone undertaking the manufacture of alloy steel castings on a considerable scale will learn before he has gone far.

To the expense of developing and training an operating staff must be added a considerable sum that must be expended in the first year or two for what might be called an experience or development fund. That is made up of the cost of the steel that does not come out right in analysis, the castings lost

in the shop through breakage, misruns from failure to properly judge pouring temperature, scabs and surface defects due to poor sand and mold conditions, pin holes and porosity due to bad furnace practice or wrong sand, and all the scores of mistakes that a green staff inevitably will make. The errors may not be so costly individually, but when added up over a term of months they will assume formidable proportions. In addition, there will be the cost of claims from customers who do not get the expected *life* from castings furnished for hard service, and the cost, often considerable, of experimenting in laboratory, shop and field in an effort to solve some difficult problem of wear, corrosion or breakage for a good customer. There is also the item of advertising expense and sales costs to be considered, for it seldom will be possible to introduce a line of alloy steel castings to the trade without incurring considerable extra cost over that of selling the regular product.

You May Be in the Red

Unless a sufficient sum is set aside to cover the development cost, it almost certainly will be found that the first year's operation in alloy steel production has resulted in a substantial red figure, which is all the more disappointing because it was unexpected and a sad contrast to the rosy visions of fat profits with which the management started the year.

The items just discussed make up the principal part of the more or less temporary extra costs involved in getting started in the production of alloy steels. Some of these items, such as claims for service not up to guarantees, the cost of experimenting with cases of especially difficult service, etc., are permanent ones, at least in part; but the bulk of the *experience fund* will have been expended during the first two years, unless the management gets discouraged and gives up before that.

There are in addition a formidable array of extra costs and expenses that are permanent. Of these, naturally, the first is the item of cost of the alloys added to the steel. That is larger than appears at first sight, because of each heat produced only a part becomes castings, the rest being returned scrap for remelting, and loss in the foundry. Of the alloys in the scrap, part will be lost in remelting; of the scrap produced, part will get mixed up with the ordinary steel, and the alloys in it will be lost for all practical purposes. The alloy cost, therefore, is a formidable one, especially in the case of the high alloy content steels. Finally, to keep the alloy steel scrap separate and properly marked for identification, so that the alloys in it can be reused for the grade of steel they belong in, is of itself an item of some expense, as it involves time and effort on the part of a number of people. The alloy steel scrap will not keep itself sorted!

In making most, if not all, of the alloy steels the production of the melting shop will be smaller than when making carbon steels. This is due in part to the necessity of more thoroughly deoxidizing the alloy steels, in part to the fact that some of these steels have to be made hotter than carbon steels, in part to the delay involved in waiting while the laboratory runs preliminary analyses on samples taken during the heat to ensure correct analysis, and finally to the extra time frequently involved in melting

John Howe Hall

down the considerable additions of solid alloys required. These and some minor items result in a reduced output, a much heavier fuel or current expense, and a correspondingly greater cost of the steel in the ladle.

Analytical work involved in the production of alloy steels, even where no preliminary tests are taken, is considerably greater than for carbon steel. The special elements added to the steel must be checked, generally in every heat, for customers will not long continue to pay for steel made haphazardly without careful control. It costs more to analyze for nickel, chrome, vanadium, molybdenum, etc., than for the elements in carbon steel, so that more and better chemists are required. That item alone runs up to a respectable figure when the cost sheets come to be made up.

For many of the high alloy steels special equipment must be added to the melting shop. Hadfield's manganese steel, for instance, can be made in an open hearth, Tropenas, or acid electric furnace plant only by providing a separate melting medium for the ferromanganese required. The ferromanganese cannot be added solid in the ladle, as the amount used is so great that it would make the steel too cold, and, if added in the furnace, the loss of manganese would be great. This necessitates either a cupola, a crucible or small electric furnace of some kind to premelt the ferromanganese, which is mixed with the steel in the ladle. In basic electric furnaces, the ferromanganese can be added in the furnace, and the scrap can be remelted with but small loss of manganese. In acid electric, Tropenas, or open-hearth practice, on the other hand, practically all the manganese in the scrap is lost in remelting and converting to manganese steel again.

The item of the loss of alloys in remelting is a serious one in many cases. Nickel and molybdenum are not lost in remelting, even in the converter, but some of the other elements are not so well behaved. Chromium, for instance, is largely lost in the converter, and even in open-hearth and electric furnace practice some of it is oxidized and never is recovered fully from the slag, especially in working by the acid process.

Melting Mediums Limited

In the case of the various stainless, rustless, and heat-resisting steels and alloys, the problem of securing correct analysis and of using up scrap is a serious one because in many cases it is of vital importance that the carbon be kept within proper limits. These steels seldom if ever are made in open-hearth foundries, as the market has not yet reached such proportions that large heats can be made, and many of the castings are too small to be poured from a large ladle, even if the open-hearth metal could be made hot enough.

The amount of alloys to be added makes it an impossibility to produce these steels by the converter process, for while the nickel could easily be melted and mixed with the steel in the ladle, the ferrochromium is too refractory to be melted separately and kept melted long enough to pour into the steel ladle. As a result, the electric furnace is at present the only medium used for the production of these highly alloyed steels.

We used to think of the electric furnace of the ordinary arc type as the panacea for all our ills. It could be used to remelt almost any material with but small loss of the alloys contained, almost any composition could be made in it, and it would produce metal as hot or as cool as we wished. Experience, as always happens, has shown us that our earlier hopes of having found the trouble-proof process were, as Mark Twain said of his reported death, "Greatly exaggerated." In many of the high chrome nickel steels it is vital to control the carbon within narrow limits, and especially to keep it very low. Higher percentages make these steels less rust proof, and much more difficult to drill and machine. In using all new materials, a

low carbon nickel steel bath is prepared and heated up, to which the low carbon ferrochrome is added solid in batches. The opportunities for the carbon to go up by absorption from the electrodes are all too many, and carbon once taken up by the bath cannot be ored out without great loss of chromium to the slag, which would require a long time and a lot of expensive power to reduce and return to the metal. A heat that has picked up carbon, therefore, is usually poured with all its sins upon its head, and, if the carbon is too high, it is scrapped.

With careful practice this carbon absorption generally can be avoided when no scrap is being remelted. If the charge is made up largely of high alloyed scrap, on the other hand, carbon pick-up is likely to take place in melting down, and once it has occurred, as already explained, there is no practical means of undoing the damage.

For these reasons it has been found to be rather difficult and costly to produce this class of steel in the arc type of furnace. This is especially true if the furnace is being used for the production of high carbon steels as a principal product, with high nickel chromes for an occasional heat. The furnace bottom in that case becomes saturated with the high carbon metal, resulting in a high carbon melt-down when stainless is produced, unless one or two wash-heats of plain carbon steel are put through to clean up the bottom before charging the nickel-chrome heat. That is especially true of basic furnaces

No Carbon Pick-Up

The induction furnaces are better suited to the manufacture of the stainless steels, as there is no carbon pick-up and little change of composition in melting scrap and alloys in these furnaces. What is put in comes out with exceedingly little loss. The factor of bottom contamination, too, is of less consequences with some of those furnaces, as it does not cost much to have several furnace bodies on hand, using each body for a different class of steel. The bodies cost comparatively little, the main item of expense being the electrical equipment. However, in a plant already equipped with an arc furnace, it is a pretty costly matter to install an induction furnace for the special product.

Again, and this is an item frequently not foreseen, it always is a difficult matter for the newcomer in the manufacture of alloy steels, especially the stainless varieties, to secure enough orders to make up a heat of the size required for the melting medium already installed in his shop. That results in great delays in making deliveries of trial orders, for of course the beginner will find it difficult, if not impossible, to secure trial orders for more than small quantities, as his customers hesitate to take chances on him till they are sure he can make a good article. More serious than the delays in delivery is the fact that the newcomer in the game is forced to make his experiments and try out his foundry methods on a large instead of a small scale. The stainless steels cannot be made successfully by the melting and foundry methods used for carbon steel castings, so that considerable experimenting has to be done, a good many false moves made, and many castings condemned to the scrap heap before the new art is mastered. When the experiments are carried out on a production scale, the cost is great.

Try It Out First

The obvious way to take care of this is to install a small scale unit which can be used for experimental work, and for the production of the trial orders that will be received during the first year or so, before the business in any one class of steel has been developed to the scale where a larger unit can be kept busy. Of course, the small furnace will be used only at intervals after the first year or two, unless a number of different varieties of steel are to be produced, each of which must pass through the development stage. The installation cost of this small scale unit is considerable, but it is practically impossible to develop a line of rust-proof or corrosion-resistant steels without one.

In the molding department, special materials, and frequently special equipment, must be purchased for the manufacture of alloy steel castings. The low alloy steels may be molded and poured successfully with the sands, flasks and machines used for carbon steel work, though it is surprising to the novice to find how difficult it is to get such a metal as, for instance, a normal chrome-molybdenum steel, to set sound and smooth in the type of molds used for regular practice. The high alloy metals, on the other hand, often, if not always, require special facing and core sands, quite different in all their characteristics from those to which the men in the shop are accustomed, the materials have to be kept separate, and milled and mixed in special batches or even in their own machines, making an item of no inconsiderable extra cost, for every time a special material has to be prepared and supervised, someone has to be paid to see that the job is done right, or a lot of expensive castings will be ruined.

Again, it often will be found that the only class of alloy steel castings for which orders can be obtained is quite different from what the shop has been in the habit of making. The castings have been averaging from 25 to 200 pounds, let us say, and the sales department finds that orders for high alloy steel castings of that weight simply are unobtainable, as other foundries already have the business and are turning out a satisfactory product. The would-be producer of a side line of alloy steel castings finds that all he can pick up is extremely light, difficult work that the other shops, for one reason or another, have not wanted. The existing line of flasks and molding machines is unsuited entirely to producing the new product, and the bill for suitable equipment is formidable. On the other hand, it must be paid if the work is to be attempted, as no one in his sober senses would undertake the work offered without suitable tackle.

What seems like a minor item, but is really often quite costly, is the problem of using up the last few hundred pounds of heats of special composition. To have enough metal to complete an order for some special steel, it is of course necessary to melt down a larger heat than actually is needed, to allow for loss in skulls, spills, possible runouts, etc. When all the molds are poured, the extra metal has to be disposed of, and often has to be pigged and used for remelting. The resulting loss of yield of good castings per ton of steel in the ladle is frequently a costly item.

Heat Treatment Necessary

It may be stated without qualification that none of the alloy steels should be shipped without heat treatment, and that generally the old-fashioned plain anneal given castings is quite inadequate to bring out the best properties of the steel. In fact, for many of the uses for which low alloy steels are being offered today, a properly heat treated ordinary steel, or at best a steel such as the intermediate manganese product, is all that really is required. In these cases instead of going to alloys to solve their difficulties and attract customers, what the foundries should do is to install up-to-date heat-treating equipment, and use the *air cool and draw* or some similar type of heat treatment. That work cannot be done in the old-fashioned *annealer* designed to heat castings up to some temperature or other and cool them off slowly, but demands modern furnaces. These are usually so much more economical in fuel as to pay for themselves in a short time, compared with the obsolete brick piles we still see in some shops, but their first cost is a fair-sized item.

Some of the high alloyed steels require quenching in oil or water, or at least cooling in air after removal from the furnace, which means special equipment, expensive in the case of oil quenching, with the necessary circulation of the oil through a cooling system. No heat treatment process can be controlled with sufficient accuracy without pyrometers intelligently installed and handled; another expensive installation. Take it all-in-all, the items of heat treatment equipment and heat treating cost make quite a showing on the cost sheets of the alloy steel maker.

Perhaps at this point some hard-

boiled, hard-headed steel foundryman, if he has read so far, will lay this article down with a contemptuous smile, concluding that the author is just another of those white-collar nuts that are such a nuisance nowadays, trying to tell real men how to conduct their business. "I guess a little old-fashioned soaking anneal and about a per cent of nickel will give me the results I need, and let me take the trade of the So-and-so company in a walk," he says to himself, and he goes to it to show the cock-eyed world a thing or two. Very well, more power to him—may he live a hundred years and die of riotous living! Only he will probably wake up in a year or two to find that his competitor with a cheaper metal, properly heat treated in an up-to-date plant has taken the business from him so easily it was just like stealing the baby's candy.

Has High Ideas

We have already mentioned the extra grinding and finishing required for some of the high alloy steels, which cost many times more than the simple *snag, sandblast and chip* needed for carbon steels. What we have not pointed out is that for every cent increase in the selling price of the product, the degree of accuracy and finish demanded by the customer goes up amazingly. His ideas of the proper appearance of a 15 or 20 cent article is far more exacting than what he expects in a 5-cent job. That means, of course, that defects that would pass without question in the old product will not be tolerated for a moment in the new, but must be fixed up at greatly increased cost. Last, but not least, it means greatly increased rejections because these defects are far harder to repair by welding in alloy steels than in carbon steels. Even a medium carbon, nickel chrome steel is a difficult metal to weld successfully if the weld is to be strong, and some of the high alloyed steels are next to impossible to weld. Naturally, then, the cost of welding will be greater with alloy steels; first, because it is a more difficult task, requiring more time and better men, and second, because more welding will be demanded on the alloy steel castings to suit the customers' demands for appearance. But over and above that cost will be that of the rejected castings that cannot be welded satisfactorily and have to be scrapped. The percentage of wasted castings will take a tremendous rise when alloy steels are introduced into the shop.

Finally, and this is an item whose magnitude can only be learned by experience, there is the extra cost involved in keeping lots or heats of special steels separate and properly identified as they go through the shop. That must be done if the special materials are to receive the proper heat treatment, and the particular care and attention in the cleaning room and the inspection floor that must be given them, and indeed if they are not to get mixed up with the regular product. It doesn't sound costly to do this, but any shop that undertook during the war to keep furnace heats separate for government inspectors will have a lively recollection of how it slowed down production and increased costs.

There are a few more minor items that might be mentioned, but this article already is beginning to "stretch out to the crack o' doom," like Banquo's regal line paraded by the incantations of the witches before the agonized gaze of Macbeth, and had better be brought to a close. The author wishes to urge in conclusion that before deciding to enter the alloy steel casting field, the foundryman should be willing to believe that, like the married state as described in the prayer-book, it "is not by any to be entered into inadvisedly or lightly; but . . . discreetly, advisedly, soberly," etc. Returning to the three classes of prospective makers of alloy steel castings that were described at the beginning of the previous article, the author hopes that the third will soon repent of his sins and amend his ways, that the second will see his error before it is too late and withdraw from the "path that leadeth to destruction," and that he has helped the first, if ever so little, to apply a truer yardstick to the problems with which he is confronted.

This is the second and concluding article by Mr. Hall on "The Lure of Alloys." The first installment appeared in the July 15 issue.

THE EDITORS.

Sectional Committee Is Organized

Organization of the sectional committee on standardization of foundry equipment has been completed under the procedure of the American Standards association. E. S. Carman, president, Edwin S. Carman Inc., Cleveland, is chairman of the committee, and John J. Baum, development engineer, Steel Founders Society of America, New York, is secretary.

The work of the committee has been divided between three subcommittees which will cover the following subjects: Subcommittee 1, pattern plates; molding machine parts affecting interchangeability of patterns; flask pins and holes; and general dimensions of stock flasks for jobbing work; subcommittee 2, ladle and ladle shank sizes; ladle sleeves, stoppers, and nozzles; and subcommittee 3, stock core print sizes, shapes, and finish allowances; pattern markings; rapping plates; fillet sizes; dowel pins for metal patterns and metal core boxes.

The project is under the joint sponsorship of the American Foundrymen's association and the American Society of Mechanical Engineers. Membership on the committee includes foundry and other societies.

Foundry Issues Bulletin

Detroit Steel Casting Co., Detroit, recently issued an interesting bulletin describing the laboratory facilities of the company. Illustrations show the various control departments such as chemical, physical, sand, microscopic, and heat treating. Views of the plant also are included which show the furnace, molding, sand mixing and annealing departments. Illustrations of typical castings and micrographs of the steel produced before and after heat treatment also are shown. The latter section of the booklet is devoted to a discussion of steel foundry practice and deals with production of the metal, molding, coremaking, heat treatment, alloy contents of castings and requisites of steel castings. Service to the customer also is discussed.

Will Meet in Zurich

The first international congress of the New International Association for Testing Materials will be held in Zurich, Switzerland, from Sept. 6 to 12, in the buildings of the Swiss Federal Polytechnicum. The technical program has been divided into four groups covering metals, nonmetallic inorganic materials, organic materials, and questions of general importance. Eight papers will be presented at the meeting by members of the American Society for Testing Materials. These include: "Advances in Microscopy," by F. F. Lucas, Bell Telephone Laboratories, New York; "Stress Corrosion of Metals," by D. J. McAdam Jr., U. S. Naval Experiment station, Annapolis, Md.; "Designing Concrete for High Strength, Low Permeability, and Low Shrinkage," by W. A. Slater, Lehigh university, Bethlehem, Pa.; "Stresses and Strains in Reinforced Concrete Columns," by F. E. Richart, University of Illinois, Urbana, Ill.; "Sampling Coal," by W. A. Selvig, U. S. bureau of mines, Pittsburgh; "Tests for Bituminous Materials," by Prevost Hubbard, Asphalt institute, New York, and C. S. Reeve, Barrett Co., New York; "Present Status of Particle Size Measurement," by L. T. Work, Columbia university, New York; "Calibration of Testing Machines," by H. F. Moore, University of Illinois, Urbana, Ill., and "Ideal and Practical (Test) Relations between Elasticity and Plasticity, Tenacity and Brittleness," by F. B. Seely, University of Illinois, Urbana, Ill.

Moist hydrogen and carbon dioxide are the two most serious offenders in causing surface decarburization of steel in gas-fired heat treating furnaces according to engineering research bulletin No. 18 published by the department of engineering research, University of Michigan, Ann Arbor, Mich. Copies of the bulletin may be obtained for $1 each.

Prevent Losses With Proper Gates and Risers

By Pat Dwyer

FOR convenience in presentation and also for indexing later, the alphabetical method adopted for classifying the various types of gates will be followed in this, the second main section of the field, devoted to the application of gates to various types of castings. Manifestly it is neither desirable nor necessary to take up every individual type of casting. In many instances several castings differing widely in name, may present common characteristics. A certain type of gate applicable to one, is equably applicable to the others.

Classify by Groups

Familiar examples immediately come to mind. Bushings, sleeves, liners are fairly well separated alphabetically, but so far as gating methods apply, they come under one head. The same applies to a group made up of ash pans, bath tubs, pots and troughs. The wheel family also is quite extensive including car wheels, fly wheels, gear wheels toothed and blank, driving wheels, pulleys, propellors, sheaves and water wheels.

From the foregoing it is apparent that many castings will draw none or at most a brief comment, while others will be described more adequately in relation to the gating methods adopted for their production.

Anvils employed by blacksmiths present several peculiar features and the methods employed for gating and pouring these castings vary to some extent from those employed on other castings. The mold is made in a 3-part flask and is gated at the bottom in close proximity to the steel plate inserted at this point to form the face of the anvil. To promote and insure a close union between the steel and the iron, the plate is raised to a high temperature before the iron is introduced through the gate. This is accomplished by pouring molten iron through a small gate into a chamber in the mold under the plate.

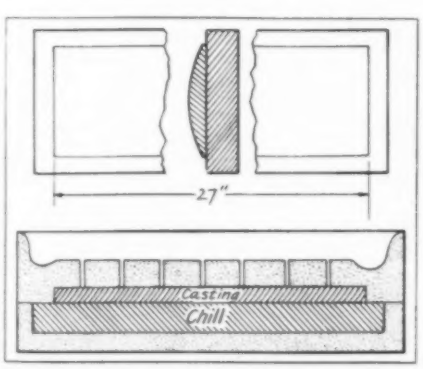


Fig. 72—Chilled Casting Is Poured Through a Row of Small Pop Gates

Pour Fast

THIS part begins the second of two main sections into which this series of articles on gating gray iron castings is divided. As in the first section the material will be presented so far as possible in alphabetical order. Iron must be poured as rapidly as possible in all molds where part or all the face is made up of metal, irrespective of whether the metal is designed to form part of the ultimate casting, or simply designed to act as a chill or even as a cooling medium or densener. Chills introduce many additional factors into the usual molding problem and the gating system must be adapted to meet these conditions. Methods of pouring and gating chilled wheels differ from those employed in pouring flat plates or chilled rolls.

When in the operator's judgment, the steel plate has attained the maximum temperature, the iron is poured into the mold and allowed to flow over the plate and out through an opening at the opposite end. After a certain amount of iron has flowed through in this manner, the hole is plugged and the remainder of the mold is filled with metal. The actual amount required to insure fusion of the steel plate, depends on many factors, including size and thickness of the plate and temperature of the molten iron. A nice degree of skill and judgment is required on the part of the workmen to synchronize the various factors. Men engaged on this class of castings develop a kind of sixth sense, by which they know when the molten metal has taken a firm grip on the plate.

One and sometimes two large feeding risers are required on top of these castings. On account of the hour glass or wasp waist shape of the casting, the lower part of the casting has to be fed from the top and the top in turn has to be fed through one or more risers.

Casting Must Be Fed

This is one of the instances where a shrink hole large or small would not impair the usefulness of the casting to the slightest degree. In fact it is an open question whether an anvil cored out to a reasonable thickness would not function just as satisfactorily as one that is perfectly solid. However, in actual practice the anvil casting must be fed up solid to pass inspection.

In the foregoing example it will be noted that the iron must be poured as rapidly as possible at first to insure a union with the steel plate. This is a feature which obtains in all molds where part or all the face is made up of metal, irrespective of whether the metal is designed to form part of the ultimate casting, or, simply designed to act as a chill or even as a cooling medium or densener placed inside the casting.

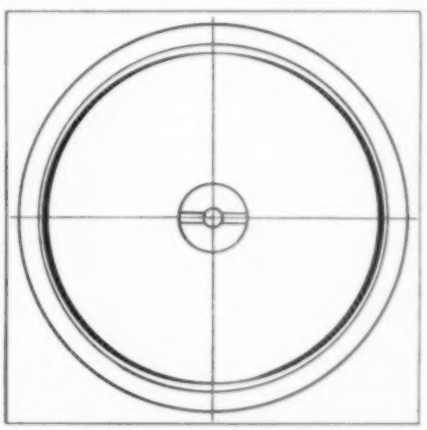


Fig. 73—Chill Is Deeper At Points Opposite the Gates

In the first instance where a union is desired, speed is necessary to wash away the first film which forms and which if allowed to stand would cause the plate and casting to part after both had cooled. In the second instance, surface tension accentuated by rapid cooling would form ridges or waves on the face of the casting. For this reason the slow pouring method, although excellent in itself and highly desirable for many reasons including its promotion of even and slow solidification of the casting, cannot be practiced in chill molds or in molds where chills are employed extensively.

The casting shown in Fig. 72 is fairly typical of a large number of castings poured against a chill face. Although the gating method is not to blame for all defective castings of this kind, still it is an important factor and must be adjusted to function harmoniously with the other factors usual and unusual connected with the production of chilled castings.

Change Pouring Position

On a first attempt where the casting is gated in the usual manner at the end or the side, the face of the casting in contact with the chill will show a rough, irregular surface. The molder will feel inclined to blame the coating material and will change day by day from one to another until he has exhausted the usual range including blackwash, plumbago mixed with machine oil, kerosene oil or gasoline, soapstone, white or blue chalk, alcohol and shellac.

After exhausting the washes without finding relief, he will decide to pour the mold (a) on a slant (b) on edge and (c) on end. Usually in each of these cases the trouble is accentuated rather than diminished. In some instances part of the trouble may be due to the wash or coating placed on the face of the chill. Only slight foundry training or experience is required to warn an operator of the danger incurred where molten metal is poured over a damp surface, a surface sufficiently impervious to cause all generated steam to pass through the molten metal. In extreme instances of this kind, the resulting explosion has been sufficiently severe to blow all the sand out of the cope.

Assuming that the coating is not the cause of the commotion, the ridges and general irregularity of the surface of the casting are due to the fact that the metal solidifies instantly when it comes into contact with the chill. The iron immediately following has to climb over a ridge only to form another ridge and so on until the entire chill surface of the mold is covered.

The obvious remedy is to pour the metal fast and hot so that the chill is covered almost instantaneously. In some instances it is possible to reverse the usual process and place the chill in the cope where the metal will come into contact with it gently after previously evaporating all the moisture. The fairly thick body of metal forced gently by ferrostatic pressure against the chill face in the cope will lie quietly and result in a smooth face.

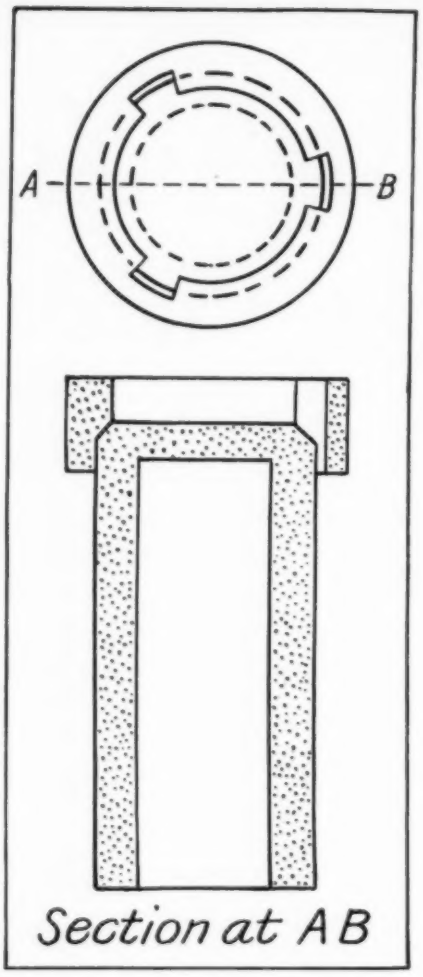


Fig. 74—Metal Enters the Wheel Hub Through Three Small Gate Openings in the Cap Core

If for any reason this plan is not feasible and the chill has to occupy the bottom of the drag, satisfactory results may be attained by providing a multiplicity of gates through which the metal may be forced rapidly. In Fig. 72 a row of seven ⅝-inch diameter pop gates deliver the metal along the center line of the casting. A long narrow basin on top of the cope embraces the line of pop gates and is supplied with metal maybe from one, but preferably from both ends. The correct amount of metal required is calculated in advance (see Part VI, March 15 issue) and taken in the ladle or ladles. The entire amount is dumped as rapidly as possible into the long basin. Needless to say the chill must be perfectly dry and preferably warm.

Coating Is Watched

Any of the materials listed previously will prevent accumulation of moisture on the face of the chill. However, they must be used with discrimination. An over dose of coating material will develop a quantity of gas which has to escape upward since manifestly it cannot pass down through the chill. Passage of this gas tends to agitate the metal and helps in the formation of ridges and other irregularities on the face of the casting. The ideal coating is thin molasses water and plumbago dried on the face of the chill, preferably in the oven. Shellac is satisfactory if applied thin. So is kerosene oil and plumbago rubbed over the face of the chill with a brush or a handful of waste. However, the coating is only of secondary importance. The main features are a dry chill, hot iron, large or numerous gates and fast pouring.

Importance of filling the mold rapidly is recognized by the makers of chilled rolls and chilled car wheels. Roll gates will be touched upon later. Gates upon chilled wheels may be divided into two main classes. In one the metal enters the hub of the wheel at the top. In the second the metal enters the mold near the bottom of the hub. In the first instance the three or four pop gates are located on the outside of the center core. In the second instance a sprue extends to the bottom of the center core and discharges the metal through three or four horizontal

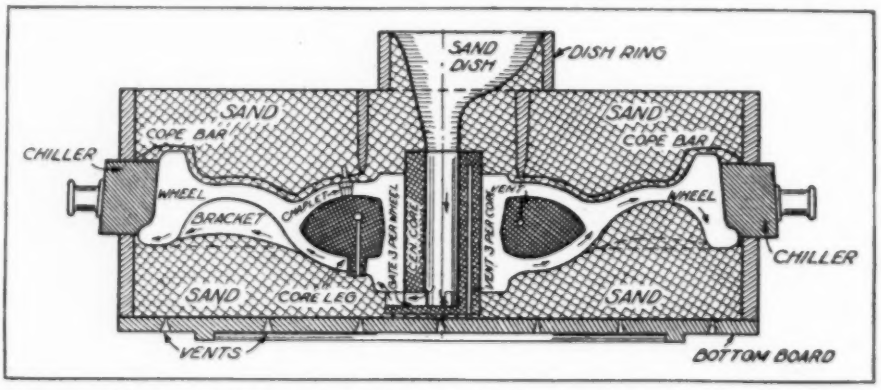


Fig. 75—Metal Falls Through Sprue in Center Core and Enters the Hub At the Bottom Through Three Small Gates

gates at or near the bottom.

The first method is illustrated in Fig. 74. The metal is poured into a round basin set above the center of the cope. The basin retaining ring is attached permanently to the cope flask and the basin is formed by placing a tapered block on top of the hub on the wheel pattern and ramming sand around it at the same time the remainder of the cope is rammed. A ring core provided with three gaps 1 x 2 inches is placed on the hub of the pattern before the runner block is set in place. Thus this core is anchored in place and forms a dry sand bottom for the reception of the metal. The center core in the wheel fills the opening in the ring core with the exception of the three gaps which serve for gates. In some instances the ring core is extended upward to form the entire basin, but in the majority of instances green sand is found quite satisfactory for this purpose. The basin is filled with the first dash of iron from the ladle and then is kept filled. Rapid pouring is necessary to keep the basin filled and this rapid pouring in turn, fills the mold in a minimum period of time determined as best by experience.

Serves as a Check

So many factors effect the successful production of chilled car wheels that every effort is made to insure uniformity through every step of the process. The temperature of the iron and the speed with which it enters the mold are reflected in the depth of chill and in the presence or absence of certain defects, notably chill cracks on the tread. Conditions vary to some extent in different foundries and as a result the size of the gates vary some on any given size wheel.

A little preliminary work and slight adjustments in the size of the gates and the pouring basin, usually are sufficient to determine the best relationship. In every instance the size of the pouring basin is ample to supply the gates. The gates constitute the check or choke and regulate the amount of iron which enters the mold in a given time. The number of gates and sizes given, three gates each 1 x 2 inches, constitute a standard on 750-pound wheels in a number of wheel shops.

In a second method practiced to some extent the mold is gated as shown in Fig. 75. This illustration, a longitudinal section, also shows the relative position of practically all parts of the mold, chill and cores. The molten metal is poured into a basin on top as in the first instance, but instead of entering the hub through three vertical gates at the top, it passes down through a sprue in the center of the center core and enters the bottom of the hub through a number of horizontal gates. This method of gating, although not confined to chilled wheels, was described in Part XII and one variation was illustrated in Fig. 57. For obvious reasons the majority of wheelmakers favor the first method.

On account of the rigid inspection to which chilled car wheels are subjected, the product is remarkably uniform. The processes and methods in many respects might be copied to advantage in the production of other chilled castings. On some types of sheaves and sprockets a uniform depth of chill is required on the working face. If a test block poured from the same iron mixture shows the required depth of chill, the foundryman assumes that a uniform depth of chill will be found all around the rim of the wheel. Sometimes he is right, but occasionally a broken wheel shows that he is wrong. If one of these wheels is broken at several points on the rim it will show a heavy chill in certain areas and little or no chill in other areas.

The maximum depth of chill is influenced by the composition of the iron, the thickness of the chiller and the temperature of the iron. The uneven distribution is influenced principally by the number and location of the gates. Hot iron will chill deeper under similar circumstances than iron that is comparatively cool. Iron that is poured cold will present a smoother skin than iron that is

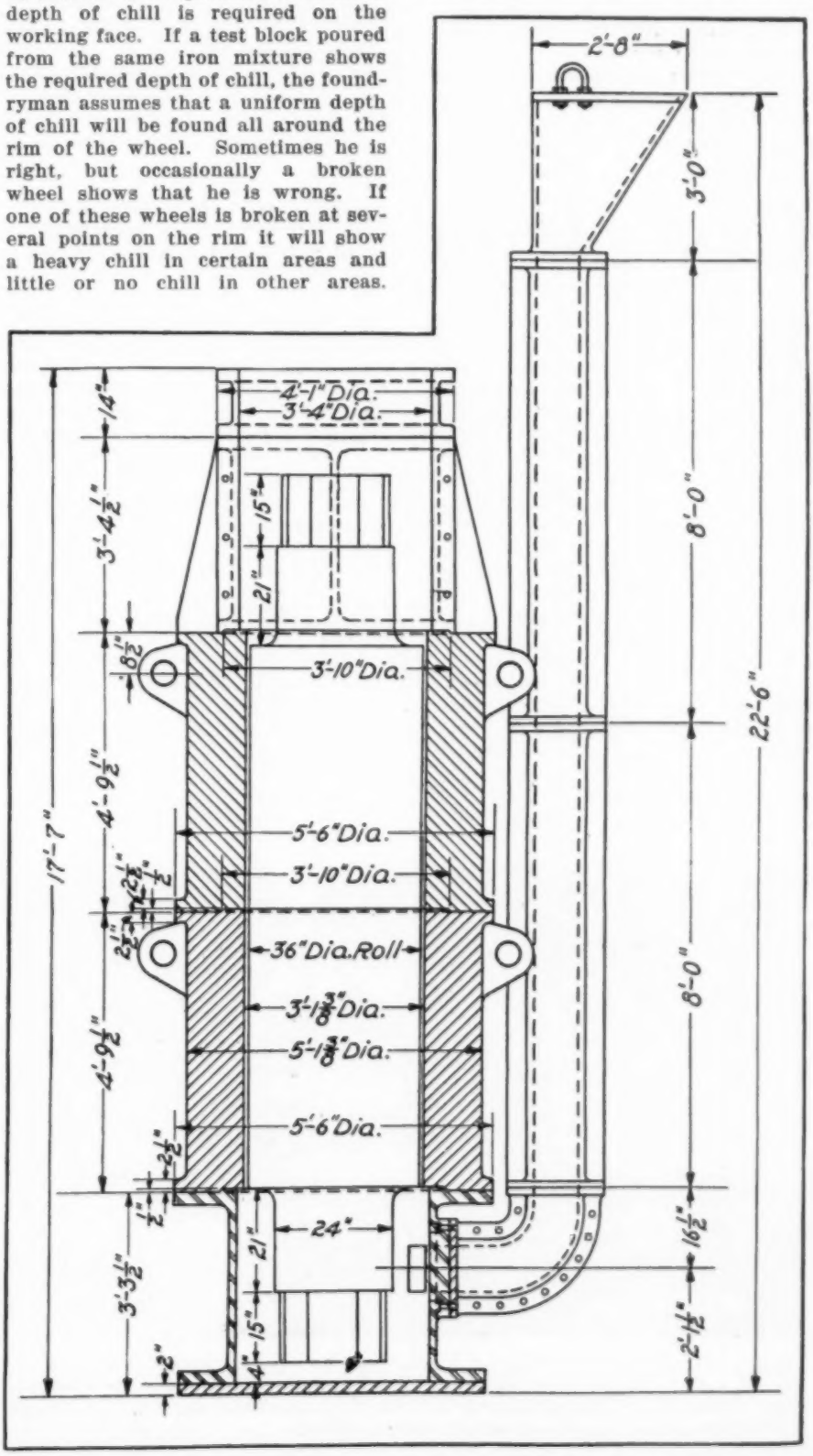


Fig. 76—Longitudinal Sectional View of Mold for Chilled Cast Iron Roll Showing Gating and Pouring Features

poured hot. These factors supply a basis for the following theory to account for the erratic depth of chill in some wheels.

Where iron is poured through one or two comparatively small gates it rapidly loses temperature. With a chilled mold this loss is accentuated particularly at the points nearest to the gate or gates. This point is illustrated in Fig. 73, a small wheel poured through two small gates located diametrically opposite each other in the bottom of the center core. Practically the same effect would follow the use of two small pop gates on top of the hub.

The molten iron comes into contact with the chill at two points opposite the gates and a great deal of heat is absorbed in its journey round the ring. At the point where the two streams meet the iron is not hot enough to chill deeply. A wheel poured under these conditions and broken would show a chilled area of maximum depth opposite the gates and gradually decreasing through an arc of 180 degrees.

The remedy of course is to pour the metal more rapidly, either through larger gates in the present position, or, preferably through a greater number of gates on top of the hub. With an even distribution of hot metal the effect of the chill will be imparted uniformly to the face of the wheel.

A sectional view of the gating system and the equipment employed in the manufacture of chilled iron rolls is shown in Fig. 76. The large basin at the top of the sprue is designed to receive the metal as fast as it can be dumped out of the ladle. Although the face of the casting must present a spotless surface when finished, no attempt is made to strain or skim the iron entering the mold. Dependence for a clean casting is placed upon the speed with which the metal is driven and the circular motion imparted to it by a tangential gate attached to the bottom neck. Any dirt in the iron is drawn to the center by the whirlpool action and carried up into the open head on the top of the casting.

This is the fourteenth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The fifteenth installment will appear in an early issue.—THE EDITORS.

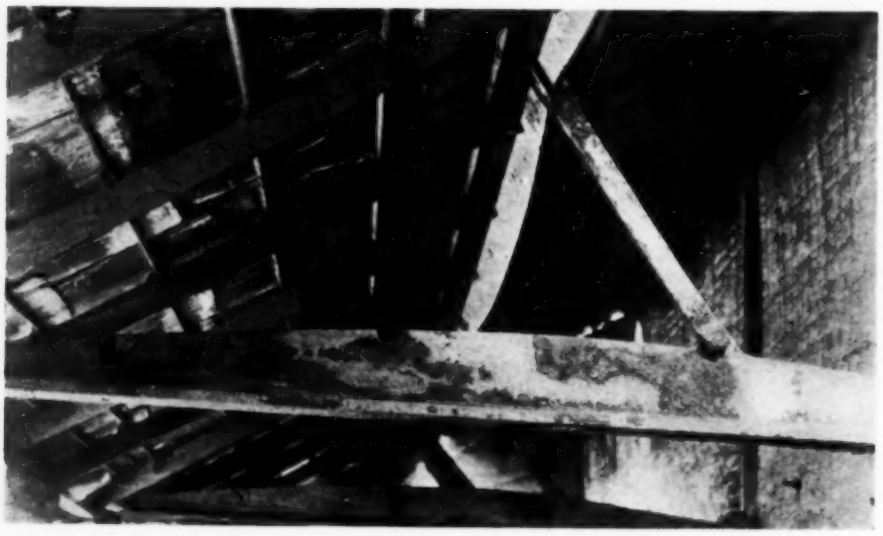
Cast Iron Supports Old Roof

PRACTICALLY every person connected in any way with the industrial field is familiar with the prominent part played by cast iron in the building industry up to comparatively recent years. The so called house work shops were among the leaders of the tonnage producers in the eighties and nineties of the past century. However, only a relatively small number of people in the same list ever have seen or heard any reference to early attempts to use cast iron as a building material, according to the *Cross Section*, a publication of the H. K. Ferguson Co., Cleveland.

The first factory buildings were built with oak timbers, brick or stone walls and roofs of stone or slate and were natural outgrowths of previous building experiences. In the early years of the nineteenth century, men of inventive mind began to experiment with wrought iron and cast iron in an effort to find more economical methods for spanning large areas. The accompanying illustration is an example of these early gropings toward a practical basis for design. A step in the evolution of the modern industrial building.

The accompanying illustration shows the interior of a building in the historic Soho Foundry group at the plant of W. & T. Avery Co., Birmingham, England. The Soho Foundry is known as the cradle of modern engineering. Here, James Watt developed his famous steam engines from his first crude inventions. Here also William Murdock earned his place in the engineering hall of fame as father of the steam carriage, the bicycle and the first practical system of lighting by coal gas.

In this roof structure of cast iron all members are subject to compression or bending strains. They are assembled without bolts or rivets, or any pretense at truss design. The small subrafters directly supporting the heavy stone roof are provided with end lugs to insure fixed position on the main rafters. Lugs on the upper side of the main rafters hold the subrafters in line. Slots on the lower side engage the purlins. Arched design of the purlins takes the increased bending moment. Short struts convey the roof loads directly to the main horizontal beams through a pin connection. The vertical web of this main beam gradually increases in height toward the center to take the maximum bending moment.



Beams, Struts, Purlins, Rafters and Sub-rafters in This Roof Over a Building in the Old Soho Foundry, Birmingham, England, Have Been in Place for Over 100 Years. They Are Held Together by Suitable Lugs and Slots and Without Benefit of Either Bolts or Rivets

An unused slot in this member would seem to indicate some thought of inserting another short strut to form a *V* support to hold the roof against any sliding action due to the slope. As it is now, the building walls must resist the side thrust of the heavy roof.

The roof of the Bull Field Mill, Bolton, England, erected in 1823 is supported on cast iron arches of pleasing semi-elliptical design, each one of which was cast in one piece. These castings reflect a great deal of credit on the foundry in which they were produced. They provide a clear span of 38 feet with 10 feet of head room at the highest point of the arch. The beam is 6 inches deep with a 5-inch flange on the top and a 2½-inch flange on the bottom.

Compared with examples of modern plant construction, these pioneer roofs appear crude indeed, but against their background of medieval architecture they represent a long advance. They have stood the test of more than a century of existence and it will be interesting to note if any of their successors will show equal resistance over such a long period.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Use By-Product Coke

We have been advised that by-product coke is as satisfactory as 72-hour beehive oven coke for use in the cupola, but we hesitate to make the change and will appreciate your opinion.

You do not need to hesitate. By-product coke now is used to a considerable extent for melting iron in the cupolas of foundries in the United States and foreign countries. Owing to the great advances in the coke making industry in recent years the characteristic 72-hour beehive coke in large pieces and presenting a silvery fracture no longer is regarded as the standard by which coke is judged. All coals are not suitable for coking purposes, but for all practical purposes it is safe to say that any by-product coke offered by a reputable manufacturer may be used with perfect confidence by the foundryman. Under the standards adopted by the American Society for Testing Materials, the following limits in chemical composition are given for metallurgical coke: Volatile matter, not over 2 per cent, fixed carbon not under 86 per cent, ash not over 12 per cent and sulphur not over 1 per cent. The foregoing in no manner disparages the estimable qualities of 72-hour beehive oven coke.

Q & A

Melt in Small Cupola

We shall appreciate some information on how to operate a small cupola 15 inches diameter inside the lining, 60 inches total height and with tuyeres 12 inches above the sand bed. We propose melting from 500 to 1500 pounds of iron per heat for small castings. What is the correct height and weight for the coke bed and for the coke and iron charges? We have a positive pressure blower with a capacity of 1½ cubic feet per revolution. At what speed should this blower run?

The character of the coke available in any locality is the deciding factor on the proper height of the coke bed. Commence with a bed extending to a height of 36 inches above the tuyeres and then gradually cut it down on succeeding days until the condition of the iron shows that it is too low. In some instances a bed of 30, and in extreme instances of 24 inches, is sufficient, but in a particularly small cupola the bed must be higher than in one where a larger volume of fuel is burning. In fact most of the standard rules for cupola operation are subject to modification, depending on the diameter of the cupola. A complete treatise on this subject *Melting Iron in the Cupola* is now available and may be obtained through THE FOUNDRY.

For your present purpose it is sufficient to say that your 15-inch diameter cupola may be operated satisfactorily on a bed 3 feet above the tuyeres. A 4 to 6-inch split of coke should be placed between the charges of iron. The iron charge should weigh approximately 8 times the weight of the coke split and should be broken small. The coke also should be small, to pack closely. A 15-inch cupola should melt about 1000 pounds of iron per hour and therefore should consume about 16,500 cubic feet of air in that time, or about 275 cubic feet per minute. That means a blower speed with your present blower of 183 revolutions per minute.

Q & A

Employ Larger Molds

We shall appreciate your opinion on the most economical method of producing hard iron grinding balls 2 inches in diameter. At present we are making them in a snap flask, 10 castings to a flask, and a molder puts up 80 flasks in 8 hours. He also cuts his sand and pours his iron. The patterns are mounted on a plate and the mold is rammed on a hand squeezer. Under our present restricted schedule we only cast every second day and that imposes a heavy burden on the three molders who are engaged on the balls. Each one has to carry and pour about 27 ladles of metal. Recently we tried out a chill mold, but it was not satisfactory. The mold contained 25 ball cavities, but on the first attempt the metal only filled 1½. We got 3 the next time and five on the third and last attempt. The cupola charge for these castings is 800 pounds steel scrap and 5 pounds ferrosilicon and of course the resulting metal is rather sluggish.

If your present output of about 2500 pounds of castings per day represents the normal demand, we doubt if you can adopt and operate permanent molds to any better advantage than molds made in sand. Grinding balls are made on a large scale successfully in many places in iron molds, but the installation is quite elaborate. The initial cost is so high that it is only justifiable by a large daily production. A typical installation of this kind was described in THE FOUNDRY April 15, 1926, in operation at the plant of the Nevada Consolidated Copper Co., McGill, Nev.

In your case you could follow the method practiced in many malleable

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions must be addressed to the Editor, The Foundry, Penton Building, Cleveland.

iron foundries where these castings are made quite extensively. Comparatively large flasks are used, approximately 18 x 30 inches. The pattern plate for this flask will contain approximately 40 balls, four rows, 10 in a row, with a main runner extending almost the full length of the flask, connected to a row of balls on each side, and with supplementary gates connecting the outside row of mold cavities with those near the runner. The main runner is formed in the cope and is quite heavy to serve as a *shrink bob*. The gates are on the drag side of the pattern plate.

The advantages of that method are that the production is quadrupled with comparatively little more equipment and the amount of bodily labor is reduced to a considerable extent. Two men on a single machine will put up more than three men with your present method in the same period of time. If the job is fairly permanent you easily could set up a light monorail for carrying a 400 or 500-pound bull ladle and thus take all the back-ache out of the pouring period. You might get in touch with the various molding machine manufacturers whose addresses are in THE FOUNDRY. They will be glad to furnish suggestions and estimates of production and relative costs.

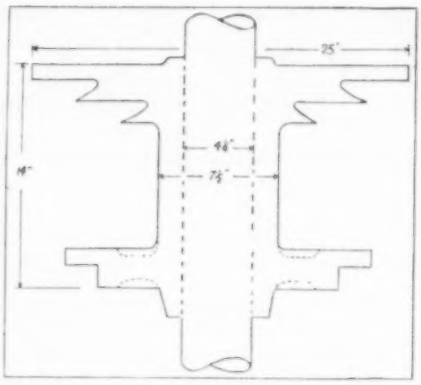
GRAY IRON

Cast Hub on Shaft

We are having trouble with a wheel casting in which a steel shaft 4½-inches diameter is placed in the center instead of a core. The metal does not unite with the shaft and does not even grip tightly although we have tried various expedients. We have drilled rows of staggered holes ¾-inch diameter and ¾-inch deep in the shaft and we have machined grooves in the face, but in the finished casting the shaft is loose. The shaft is heated with a blow torch and the mold is not closed until the metal is ready to be poured into it. We shall appreciate your advice on how to anchor the shaft solidly in the casting.

The shaft may be anchored solidly in the casting by continuing to pour iron through the mold until the surface of the shaft is raised to a welding heat and fuses with the molten iron. This procedure presents practical difficulties in the particular instance selected for illustration. In addition to the difficulty of effecting a proper weld, you also will experience the practical impossibility of keeping the shaft perfectly in the center and as a result the machinist will have his own troubles in trueing up the shaft and rim. The best way to make the job is to core the hub of the wheel, then machine it to fit the shaft and fasten the shaft with a key in the usual manner.

However, in the event that you have no choice and are forced into attempting to cast the metal around the shaft, a fairly tight fit may be secured by heating the center of the shaft in a forge or other fire, placing it in the mold, pouring the iron as soon thereafter as possible and running a considerable amount through the riser. As a precautionary measure a groove ½-



The Hub Is Loose on the Shaft

inch deep and the same width should be turned in the shaft a short distance inside of each end of the hub. This will prevent any end movement. Preferably the shaft should be square in cross section, but if this is not practicable, a longitudinal keyway ¾ x ¾-inch will help to hold the shaft in place.

Your present trouble is due partly to the fact that the steel shaft still is expanding when you cease pouring. In other words the shaft still is absorbing heat at a time when the surrounding cast iron is solidifying and commencing to contract. The metal surrounding the shaft contracts and solidifies first and remains in a state of tension. The shaft contracts to its normal size later and no longer is gripped tightly.

Q & A

Use Low Carbon Iron

Can you give me some information on a good composition of metal for glass molds? It is not practical to make all our mold castings with monel or nickel and chromium additions due to the cost. Iron with a fine, tough grain is desired in which the design is cut. It is not necessary to use a chilled mold, but it seems as though the required structure is obtained with that method. I believe that with iron of the proper composition, it may be heat treated suitably to obtain a much better working surface than that obtained with chills.

The most desirable composition cannot be specified readily since the size of the castings is not given, and because different foundries often obtain iron of similar physical characteristics with quite wide differences in composition. However, a low carbon, fine-grained iron usually is preferred. Such an iron can be heat treated by heating rather rapidly to 1500 to 1550 degrees Fahr. and quenching in oil, preferably followed by a draw at say, 700 to 900 degrees Fahr. If properly conducted, the treatment will produce an extremely fine grain, and considerably increase the hardness. We would prefer a total carbon under 3.0 per cent with just enough silicon to produce a fully gray structure. Heat treatment of high-carbon, open-grained iron to improve its properties is like trying to make a silk purse out of a sow's ear.

MALLEABLE

Gives Malleable Data

I am located in Mexico and I am interested in obtaining information on making malleable cast iron in a small foundry.

Manufacture of malleable cast iron is a highly specialized art, and a considerable investment is required in melting furnaces, annealing furnaces, etc. The first product, usually termed hard iron which is brittle and has a white or nearly white fracture, is comparatively low in silicon, phosphorus, manganese, and sulphur, and the total carbon below 2.80 per cent except in the case of cupola iron. Malleable iron may be melted in the air furnace, electric furnace, cupola, or duplexed by melting in the cupola and refining in the air furnace or electric furnace. The air furnace is used to a large extent in the United States.

After the hard iron castings are cleaned, they must be heat treated or annealed to convert the combined carbon which gives the white fracture, into temper carbon and ferrite which give the resultant product its desirable physical characteristics. In annealing, the castings are placed in heavy iron pots and surrounded by inert packing material such as slag, gravel, cinders, etc. (in some instances iron oxide or silicate is used), and heated to a temperature in the vicinity of 1700 degrees Fahr. for 50 or 60 hours. The castings are allowed to cool at the rate of about 10 degrees per hour to 1275 degrees Fahr. The castings then are cooled as rapidly as possible to handling temperature. They are removed from the pots and cleaned. All told the complete annealing cycle from the time the castings enter the furnace until they are removed, occupies from 5 to 9 days depending upon the size of the castings and the properties desired.

Thus you can see that production of malleable cast iron is considerably different from the production of gray iron for example. For more detailed information on the process we suggest that you obtain a copy of *American Malleable Cast Iron*, by H. A. Schwartz, or a preprint entitled *Symposium on Malleable Iron Castings*, published jointly by the American Society for Testing Materials, 1215 Spruce street, Philadelphia, and the American Foundrymen's association, 222 West Adams street, Chicago.

The FOUNDRY Family Photograph Album

Upper Left

JOHN SLEZAK

Turner Brass Works, Sycamore, Ill.

Upper Right

H. C. MITCHELL

Auto Specialties Mfg. Co., Windsor, Ont.

Lower Left

H. W. STANDART

Northern Engineering Works, Detroit

Lower Right

W. H. ROTHER

Buffalo Foundry & Machine Co., Buffalo

TENTATIVE RECOMMENDED PRACTICE FOR

Copper 85, Tin 5, Lead 5, Zinc 5 Alloy

(*Concluded from Data Sheet No.* 870)

is suggested, keeping in mind that phosphorus and other elements have an effect on the fluidity. Zinc, tin and lead also must be added for that lost by volatilization in accordance with furnace practice.

Impurities and Their Effects on Alloy

Phosphorus is added as a deoxidizer and should be kept in close control, as it has a decided effect on the alloy. The phosphorus is best added to the pot just before pouring, and only enough should be added to reduce the oxides present. Phosphorus has a tendency to make the metal more fluid, which increases its ability to penetrate any cores present and also has a tendency to make dirty castings.

Iron is an impurity in the alloy. It is found in solution or in the free state. In both cases it is detrimental and should be kept as low as posible. When in the free state it makes hard spots, and when in solution it increases internal shrinkage and discolors the alloy.

Aluminum is an extremely dangerous impurity, and even a few hundredths per cent is likely to ruin the alloy, making it unsound. Aluminum apparently alters the crystalline characteristics of the alloy markedly, even small amounts sometimes cause lead sweat.

Antimony is an impurity that alloys well with the rest of the mixture and is hard to eliminate, as it does not burn out easily. Its effect on this alloy is widely discussed by nonferrous foundrymen and metallurgists, but good castings can be made when this element is kept within the limit of 0.25 per cent set by the A. S. T. M. specification.

Nickel is an impurity which is not harmful to this alloy. Nickel up to 0.75 per cent apparently is not detrimental. In larger amounts the alloy is not a regular 85-5-5-5, but falls into the special alloy class.

Sulphur is an impurity in this alloy. There is some question as to the amount necessary to produce distinctly harmful results. Recommended practice relative to this impurity awaits results from work now in process. Up to 0.08 per cent is not considered harmful.

Silicon is an impurity in this alloy, and it is generally conceded that it is harmful in the alloy as the silicon reacts with the lead and gives drossy and dirty castings. Even a few hundredths of one per cent should be avoided.

Revision

The committee on recommended practice expects from time to time to make additions, corrections and revisions as increased information becomes available.

TENTATIVE RECOMMENDED PRACTICE FOR

Manganese Bronze Alloy

Development and Field of Use

This alloy was developed by P. M. Parsons in 1876. Strictly speaking, manganese bronze is a high-tensile complex brass and owes its remarkable properties to the incorporation of one or more of the elements aluminum, iron, manganese and tin in the basic brass mixture. It finds use where a high-strength, ductile, corrosion-resistant, nonmagnetic metal is required; hence, it is widely used in the electrical industry and in marine and automotive work. Its composition is that given in American Society for Testing Materials Specification B-54-27, which designates copper, 55 to 60 per cent; zinc, 38 to 42; tin, 1.50 maximum; iron, 2 maximum; manganese, 3.50 maximum; aluminum, 1.50 maximum; lead, 0.4 maximum.

Physical Properties for Sand Castings

Ultimate tensile strength, lbs. per sq. in. min.	65,000
Proportional limit in tension, lbs. per sq. in.	16,000-20,000
Yield Point in tensile lbs. per sq. in.	30,000-40,000
Elongation in tension (in 2 in.), per cent	20-35
Reduction in area, per cent	15-30
Compression of 0.001 in. (on cylinder ½ in. square cross-section, 1 in. high) at	22,000-26,000 lbs.
Compression of 0.1 in. (on cylinder ½ in. square cross-section, 1 in. high) at	85,000-90,000 lbs.
Brinell hardness number	109-119
Patternmaker's shrinkage (per ft.), inches	7/32
Specific gravity	8.4
Weight per cubic in.	0.303 lb.
Resistance to impact (Izod test), ft. lbs.	15-24

Chemical Control

Close chemical control is necessary to insure the desirable mechanical properties in the casting. The strength and ductility are markedly sensitive to slight variations in the constituent elements, particularly zinc and aluminum, which also influence the shrinkage.

Sand

Considerable latitude is permitted in the grain size of the sand used on this alloy. The film of alumina carried on the surface of manganese bronze gives a fair finish even in coarse sand. A sand is recommended having the characteristics of No. 2 Albany, with a moisture content ranging from 6 to 7.5 per cent. Skin-drying or other surface treatments to secure fine finish are not ordinarily practiced on this alloy.

Abstracted from a report of the nonferrous committee on recommended practices of the American Foundrymen's association.

(*Continued on Data Sheet No.* 873)

THE FOUNDRY DATA SHEET, AUG. 1, 1931

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Problems in Nonferrous Founding

By Charles Vickers

Adds Iron to Bronze

We have been making a number of large piston rings, and the complaint is that there is not enough spring to them to suit the purpose. We have been using a mixture of 90 per cent copper, 10 per cent tin and ¼-pound of phosphor copper, additional. Is there anything better that you would suggest, as they cannot be made of steel; it is necessary to use bronze. The rings are 21 inches diameter, 1¾-inch deep and ½-inch thick.

Perhaps the purchaser of these castings thinks that bronze can be hardened like steel, and the temper drawn in the same manner by quenching to a certain stage. But this is not the case as this treatment will soften the casting.

The mixture used in this case is a good bronze spring alloy, and its quality of springing can be improved by rolling the casting, as bronze is made resilient by working it and not by any tempering method. What is needed is a high elastic limit, and as iron is better for obtaining this quality, it is possible that the following alloy would be worth a trial.

Melt copper 89.50 per cent; have a covering of at least 1-inch thick of charcoal on its surface when it is thoroughly molten. Then drop onto this charcoal bed, one pound of yellow prussiate of potash or soda. Allow this to remain until it ceases boiling, then stir it into the metal, and repeat with another pound per hundred pounds of metal. Do not attempt to stir in the flux until all boiling has ceased as it is wet, and the water must be first boiled off. Close the furnace and allow the fumes to escape. It is necessary to use furnaces having a chimney to carry away the fumes. Next add, 10.50 per cent of tin, and pour the bronze as usual. The object of the prussiate of potash is to add iron to the copper, in such a manner that it will combine with the same and not segregate in the shape of hard nodules. The 2 pounds of potash will add around 1 per cent iron, and it will also deoxidize the copper, so no other deoxidizer is needed. The iron can also be added in the form of loosely coiled strips of thin tinplate, but the results will not be so good as the iron contains carbon, and some may segregate from the copper. However it will have to be used in a case where no chimney is attached to the furnaces, as it is essential that the fumes from the potash not be allowed in the shop.

Q & A

Gives Compositions

We are to furnish main bearings and bushings for steam locomotives, the analysis of their present supply is 78.84 per cent copper; 13.51 per cent lead; 6.22 per cent tin; 0.66 per cent antimony 0.50 per cent zinc; 0.07 per cent iron and 0.16 per cent nickel. This alloy does not stand up properly. We have recommended a nickel bronze consisting of 77 per cent copper; 10 per cent tin; 10 per cent lead and 3 per cent nickel. Would that alloy be satisfactory?

The nickel bronze suggested will be satisfactory. However it is customary for the wise foundryman to add a little zinc, say 2 per cent. This addition will lessen greatly if not abolish all casting troubles and at the same time it is not at all harmful to the bearing qualities of the bronze. We do not know the analysis of the bronze asked for, but presume that it is on the order of a 80-10-10 with phosphorus, from 0.25 to 0.50 per cent of phosphor copper containing 15 per cent of phosphorus.

The analysis of the present supply of castings is too high in lead and too low in tin for bearings that have to withstand considerable pounding; it will not stand up for such service. It is undoubtedly ingot metal, and would work all right for small bearings where the alloy of 78 per cent copper; 15 per cent lead; 7 per cent tin, would be suitable. The antimony however should not be higher than 0.25 per cent.

We doubt whether it will be practical to use new metals in making the nickel bronze as railroad companies are close buyers. We suggest that you get in touch with some reliable maker of ingot and buy the composition you have in mind, and check the analysis from time to time. Be particular about the absence of aluminum, return all ingot that carries even a trace of this metal, for it is the easiest element known to remove from brass, owing to its powerful chemical properties.

Bronze Contains Holes

We are having trouble in casting bronze gears, 88-10-2 alloy, around an iron chill, as the castings, when finished, show some blow holes in the center of the teeth at one side, either by the riser or gate. The castings are gated on the side with a riser on the opposite side. We do not dry the molds and we have been painting the chill with red lead and just heating a little over a salamander.

Sir John Dewrance, a noted English authority, maintains that cast iron gives off gases in contact with brass. Therefore he coats his chills with a paint or lacquer mixed with plumbago. Shellac and plumbago is favored by some molders. As there may be some truth in the assertion that gas comes off cast iron in contact with molten brass. It would do no harm, before using a chill mold of that material, if it was first made red hot, and held at that temperature for 30 minutes, and then gradually cooling. While it is still above 212 degrees, coat the chill with plumbago by rubbing it with a piece of broken crucible.

In using the chill, heat it beyond the steam producing point, so no moisture from the sand can condense on it. A chill does not need to be cold to chill. If held at 300 degrees Fahr. it is cold compared to molten bronze. It may be that the blowing has its source in using too cool a chill. The latter must always be hotter than the sand if a chill is expected to be used successfully.

We will outline some of the methods in use to prevent blowing of metal molds or chills. (1) Warm the cast iron chill well and paint with a mixture of lard oil and plumbago made to a cream. Afterward go over it with whiting, applied dry with a camels hair brush. (2) Make a paint by mixing 16 parts lampblack and 32 parts china clay, with sufficient water to make a cream. To make the paint adhere, mix with it beforehand 5 parts water glass; (silicate of soda). Heat the molds and apply several coats; allowing each one to dry separately. (3) Heat the chill, melt some common rosin and apply with a brush, putting on a thin coating.

Special Methods Are Required

for Casting

Aluminum-Copper Alloy

By Lewis H. Fawcett

COPPER-BEARING aluminum alloys present difficulties in molding, due to relatively high crystallization shrinkage and hot shortness. Therefore, special methods must be employed in the manufacture of castings made of such alloys to overcome the effect of those characteristics. On the contrary, an alloy consisting of approximately 95 per cent aluminum and 5 per cent silicon has excellent casting characteristics. Unfortunately, the latter composition is deficient relatively in both strength and ductility as compared with a heat-treated aluminum-copper alloy containing 4.50 per cent copper.

Designs the Casting

As far as practical, castings made from an alloy of aluminum with 4 to 5 per cent copper, should be designed of uniform cross-section, avoiding abrupt changes in cross-section. Liberal fillets should be employed, round openings are preferred to rectangular ones, and rounded corners also are desirable. Frequently, patterns that are completely satisfactory for silicon-aluminum alloys are unsuitable entirely for the heat-treated alloy. When practical, patterns should be designed to permit the casting to contract away from cores instead of toward the core.

Alloy Is Tender

DUE to high crystallization shrinkage and hot shortness of alloys containing aluminum and 4 to 5 per cent copper, special precautions must be taken in molding and coremaking to guard against those characteristics. Avoidance of excessive temperature and contact with foreign material are two precepts to be watched in melting the alloy. Various points on molding, patterns, coremaking and furnace and pouring practice of the aluminum-copper alloy are discussed in this article which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association. The author is metallurgist, U. S. Naval Gun Factory, Navy Yard, Washington.

Self-coring patterns for interiors, where practical, are preferable to box cores. For large work, pattern may be designed for use of loam cores in place of using box cores. Patterns must be designed so that heavy sections will be accessible for the required shrink heads. The use of loose pieces, causing excessive overhang of mold which must be heavily secured should be avoided. Patterns should be accurate to permit assembly of cores without causing excessive finning on the completed castings.

Precautions Are Observed

General principles underlying the molding of aluminum-alloy castings apply in the main to the heat-treated alloy, but special precautions must be taken to obtain full success. In green-sand work adequate venting is important, sand control is desirable, molds should be rammed lightly and uniformly and sand worked with slightly less moisture content than is customary in the case of other nonferrous metals. Flasks should not be barred any closer than necessary to secure the mold, so as not to obstruct full contraction. Chills are absolutely necessary in large sections inaccessible to shrink heads. Brackets or tie bars often are required to prevent cracking of the castings.

Special attention should be given to cores for the heat-treated alloy. Cores must be soft and capable of being

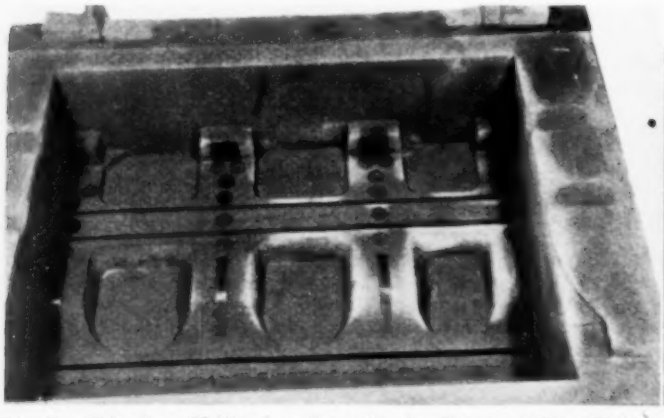


Fig. 1—Fifty-two Chills Are Used in the Drag of This Mold for a Housing Frame Casting. Fig. 2—Cope Side of the Mold Showing Risers and Shrink Heads

crushed as the metal contracts around them, so as not to crack the metal as it cools through the hot-short range of temperature. This may be accomplished by the use of collapsible cores. Care should be taken in selecting sand binders. Obtain a binder that will disintegrate at low temperatures. Heavy core rods should be avoided and liberal use of cinders or crushed coke in the interior of cores is desirable.

Serious thought should be given to gating. The longer the flow of metal from the gate before meeting an obstruction, the cleaner the castings. As a general rule, gates should be designed so that the sprues enter the smaller cross-section rather than the larger cross-section of the casting. By that method, the hot metal will be cooled by passing through long, thin sections before it reaches the larger section. That results in a more uniform grain size throughout the casting. Improperly placed gates may restrict contraction by acting as a clamp and causing the casting to crack during cooling. Before increasing the pouring temperature to run a casting, study should be made to determine if the gates could be improved.

More liberal use of shrink heads is necessary with the alloy under discussion than is the case with the silicon-aluminum alloy. Round heads are more efficient than rectangular ones. An increase in the height of a head often is more conducive to results than increasing its diameter. In general, an increase in the pouring height is not to be recommended, but the desired results may be obtained by building shrink heads or risers above the cope, pouring the casting, covering the gate with a weight and then filling the excess head with hot metal. Overflowing of heads during pouring should be avoided, as the fin produced in this manner may restrict contraction and cause the castings to crack or check.

Great care should be taken in melting, to prevent excessive temperature and to avoid foreign material coming in contact with the charge. Pouring temperature also is of great importance. A general rule than can be followed safely is to pour at the lowest possible temperature that will run the casting. Accurate control of pouring temperature should be employed because: low temperatures decrease contraction during solidification, and increase the mechanical properties of the material.

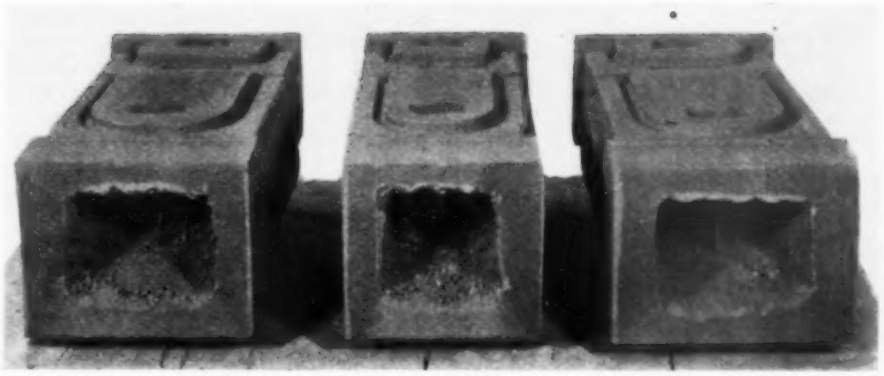


Fig. 4—Coke and Cinders Are Removed from the Interiors of the Cores

Fig. 3—Cores in Place and the Mold Ready To Be Closed. Three Vents in the Edge of the Mold Allow Gas and Air To Escape from the Cores

Gives Pouring Practice

At the Naval gun factory, metal is placed in carborundum or clay-graphite crucibles and melted in anthracite-coal-fired, pit-type furnaces. When the temperature of the metal reaches 1300 degrees Fahr., the crucible is withdrawn from the furnace and the metal poured immediately into the molds. Work is scheduled so that the mold and metal are ready at the same time. In this manner the pouring temperature for the average size work is maintained at from 1300 to about 1250 degrees Fahr.

Before pouring, the metal should be fluxed with zinc chloride, about 1 ounce per 100 pounds of metal, and carefully skimmed. Sprues should be kept choked during pouring and the metal handled quietly without agitation to prevent oxidation and to keep the castings free from dross. The ideal condition to minimize agitation is an unbroken stream poured from a low height.

Best results are obtained when the

Table I

Mechanical Properties of 5 Per Cent Copper Alloy

Designation	Pouring temperature, Degrees Fahr.	Diameter of specimen, in inches: As cast	Diameter of specimen, in inches: After machining	Tensile strength, lbs. per sq. in.	Elongation in 2 in. Per cent	Fracture
Requirements of 46Ala, Cl4	.....	.565	.505	28,000	6.0	.....
Melt No. 7233R	1250	.565	.505	36,500	12.5	Irregular
Melt No. 7463R	1220	.565	.505	37,500	17.6	Irregular
Melt No. 8686R	1300	.565	.505	29,500	10.0	Irregular
Melt No. 8710R	1260	.565	.505	35,000	13.2	Irregular
Melt No. 7558R	1220	.565	.505	33,000	8.5	Irregular
Melt No. 7576R	1280	.565	.505	35,000	16.2	Irregular
Melt No. 7636R	1280	.565	.505	31,000	8.7	Irregular (flaw)
Melt No. 7753R	1250	.565	.505	32,500	10.2	Irregular

Fig. 5—Method of Casting Test Bars for the Aluminum-Copper Alloy

alloy is compounded with the purest grades of commercial aluminum and copper. Minor constituents must be reduced to the lowest possible extent, for the presence of even small percentages of other elements may cause a great reduction in ductility after heat treating. It also is advisable to make an alloy of 50 per cent copper and 50 per cent aluminum to be used as a hardener. A representative melt would consist of the hardener with the necessary aluminum addition, plus 40 per cent scrap resulting from a former melt of like composition.

In the case of intricate work, it often is desirable to remove the casting from the mold as soon as it can be handled, and to knock out the cores to allow ease of contraction. Although great care must be taken at this stage to prevent distortion, the benefits obtained in reducing the chances for checking fully justify the effort required in careful handling.

Heads and gates are removed by sawing. The remaining bottom portions of heads then are ground to the level of the surrounding surface. If any fins are present, they are removed by grinding. After that operation the castings are ready for heat treatment.

The equipment used by the Naval gun factory for heat treating aluminum-alloy castings consists of an electric resistance furnace, about 6 feet in diameter and 9 feet deep, a quenching tank of the same capacity, and the necessary auxiliary devices. Both the furnace and tank are beneath the floor level and within a few inches of each other. The furnace top, which is only a few inches above the foundry floor, is removed by an electric motor. It is lifted slightly and moved sideways to open or close, and when closed it is sand sealed.

Heat is obtained from chrome-nickel grids located on the bottom and around the circumference of furnace. The furnace is maintained at plus or minus 2.5 degrees Fahr. of the desired temperature by automatic temperature-control apparatus. Temperature of the water also may be elevated by passing steam through the perforated coils placed on the bottom of the quenching tank. During the heat-treating operations the castings are contained in steel-framed wire baskets.

Heat treatment is accompanied by excessive distortion unless the proper care is exercised in securing the castings during the heating period. Castings are heated to 960 degrees Fahr. and held at this temperature for from 18 to 24 hours, depending on their cross-sectional areas. Thus, the heat-treating temperature approaches the melting point of the material, with the result that the castings become soft and will bend and distort unless they are properly supported. To prevent change in dimensions, when the castings are placed in the baskets they are well secured with wire and by wedges placed beneath them so that they remain in a vertical position.

It is essential that the time between withdrawing the casting from the furnace and its subsequent quenching be as short as possible, otherwise the desired mechanical properties cannot be obtained. After quenching, the basket is allowed to remain in the water until the castings have been reduced in temperature to that of the quenching water. The water generally is maintained at a temperature between 150 and 190 degrees Fahr. On being withdrawn from the tank, the castings dry almost immediately, due to their temperature being approximately 100 deyrees Fahr. higher than the temperature of the plant. Castings are shipped to the machine shop when they have been removed from the baskets.

Although heat treatment is necessary to produce the desired mechanical properties, on standing at room temperature after being heat treated this alloy will increase in tensile strength and decrease in ductility. This change in properties is called *aging*. A noticeable amount of aging will take place within a few days after the heat treatment of the material. On this account the specifications require that test bars representing castings made from this copper-aluminum alloy shall age at least 48 hours before being tested.

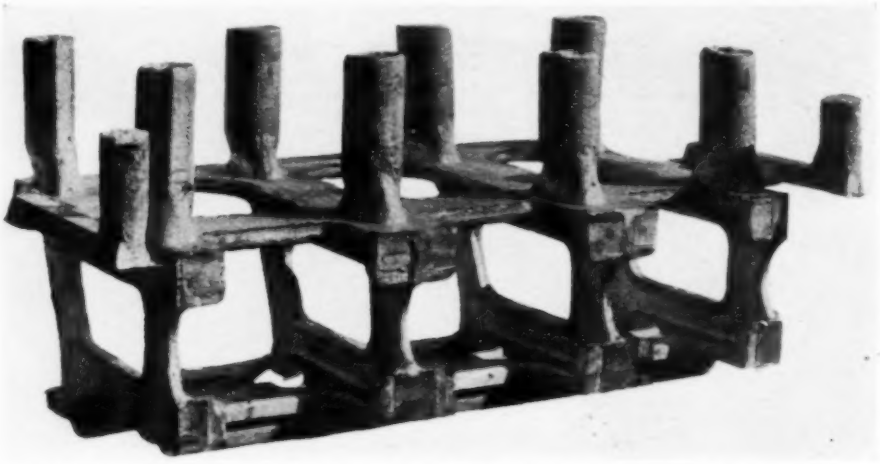


Fig. 6—Casting Showing the Location of Gates and Risers Before They Are Removed

Requirements governing the testing of this material are found in navy department specifications, aluminum alloy, light; castings, 46 Ala, class 4. The chemical analyses of two representative melts are given in Table II, and the mechanical properties of several typical cases are shown in Table I. The low content of minor constituents, as given in Table II, is a great factor in obtaining the high elonga-

Table II

Chemical Composition of Alloy

Designation	Aluminum	Copper	Silicon	Zinc	Iron	Magnesium	Manganese
Requirements of 46Ala, Cl 4	94.5 min.*	4.0-5.0	1.20 max.	0.25 max.	1.20 max.	0.35 max.	Trace max.
Melt No. 7233R	95.12	4.48	0.21	.....	0.19	.....	0.05†
Melt No. 7463R	94.98	4.73	0.13	.....	0.16	trace	0.05†

*Total of all constituents, other than Copper and Aluminum, 2.5 per cent maximum.
†Less than.

tions shown in Table I. This excess of ductility over the requirements is intended as a margin of safety to counteract the possibility of decreases in elongation by aging.

The foundry practice employed in the manufacture of a housing-frame casting, involving some of the precautions outlined previously, is as follows: Pattern, and the drag section of flask, are placed upon a follow board, designed to support fully the pattern during ramming. Chills, brackets and a bearing plate are set in their proper positions on the pattern. After the drag is prepared, the cope, which is barred, is set in place on the drag, filled with sand and rammed.

Two gates and eight sink heads are utilized in molding the cope. The usual amount of vents are made over the surface of cope, the cope is then taken off, the pattern removed from the drag, and cope and the mold finished. No. O Albany heap sand is used for facing in green sand work. Sand is worked as dry as practicable, the moisture content not exceeding 5 per cent. After finishing, the entire mold is sprayed with crude oil to protect chills and eliminate the necessity of adding moisture to sections that may have dried out while dressing.

Many Chills Used

Fig. 1 illustrates the drag. The impressions on the right and left edges of the drag are sprues made at the bottom of the gates, through which the metal enters the mold. Fifty-two chills are employed in the bottom of this drag. All of them are made of cast iron with the exception of the four narrow, rectangular ones adjacent to the three most prominent core prints. Those are made of copper. If the aluminum-silicon alloy were being used for the job, all the chills would not be necessary. Possibly only the four copper ones would be utilized.

Three tie bars are visible as impressions extending across the bottom of the mold, while a bearing plate is located forward of and parallel to the long row of round chills. This plate and the six prominent depressions or core prints furnish the foundation for three cores used.

The cope is shown in Fig. 2, with the location of the two gates and the sink heads plainly shown.

Three cores used in molding this casting are shown in Fig. 4. They are made in wooden core boves which are designed to part, to prevent the necessity of rolling over, because the cores are purposely of fragile construction and, while green, are only strong enough to withstand careful handling. The interiors of the cores are filled with crushed coke or cinders and rodded as lightly as practicable. After being taken from the ovens, these porous interiors are removed, leaving the central portion hollow as shown in Fig. 4. The prints on the bottom of the cores are likewise only a shell. Four steel rods, ¼-inch in diameter, in the top of each core, one along each edge are used. The bottom of the cores have the same arrangement of rods, only in that case ⅜-inch diameter rods are utilized.

These fragile cores facilitate contraction by crumbling under the pressure of the contracting metal, and thus avoid cracking the casting. Furthermore, they serve as exits far gas and air which may pass through them to vents cut in the top edge of the drag at points near one end of each core. Core sand used in that case consists of a mixture of 120 parts straight silica sand and 1 part oil by volume. Sand is passed through a No. 10 sieve before the oil is added. After adding the oil, the core sand is tempered carefully with water and mixed thoroughly in a mechanical paddle-type mixer.

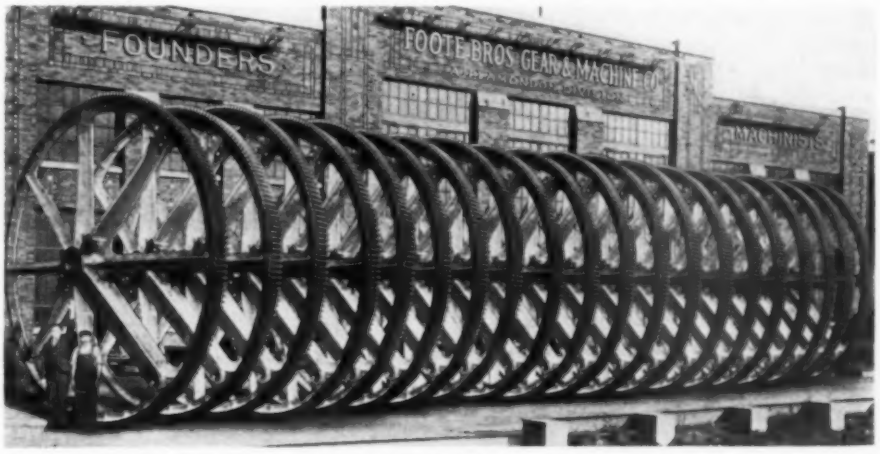
While resting on a cast-iron core plate, the core box is removed from the core, thus allowing the core to be transferred to the core ovens on the plate. When removed from the oven, the cores are painted, while warm, with wet blacking. The heat of the core quickly dries the blacking and the core then is ready to be set in its place in the mold.

When the cores have been set in place in the drag, the mold then is closed and poured immediately. Two crucibles are used in pouring, each containing about 75 pounds of metal. Pouring is accomplished simultaneously through the two gates. Pouring temperature is 1280 degrees Fahr. After pouring, the heads and gates are relieved by removing the sand from around them so that they may be free to move as the casting contracts and thus facilitate rather than retard the contraction of the casting. Fig. 3 is an illustration of the mold ready to be closed. In the background are the three vents which have been cut in the edge of the mold adjoining the end of each core to allow the escape of gas and air from the interior of the cores, as mentioned previously.

Fig. 6 shows the casting before the heads and gates were removed. This casting is about 11 x 21 x 34 inches. Fig. 5 gives a picture of the type of test bar used. It is made in green sand with two specimens per flask. Attention is directed to the four blind heads and the central pouring gate.

Cast Gears Are Used in Illinois Waterway

Hubbard Steel Foundry division, Continental Roll & Steel Foundry Co., recently cast 20 gears for the state of Illinois which will be used for opening and closing the locks in the Illinois deep water way at Lockport, Brandon Road, Dresden Island, Marseilles and Starved Rock, Ill. Foote Bros. Gear & Machine Co., Chicago, did the machine work on



An Idea of the Size of the Gears May Be Obtained by Comparing the Diameter With the Height of the Men at the Lower Left of the Illustration

the castings. Each of the gears weighed 13 tons, a total of 260 tons, and were 18 feet 10 inches in diameter with a 10-inch face. The gears were cast in the blank form from medium manganese steel. Inspection requirements of the state of Illinois are rigid requiring physical tests on each casting. Average physical results obtained from test bars on the gear castings was as follows: Tensile strength, 91,800 pounds per square inch; elastic limit, 50,500 pounds per square inch; elongation in 2 inches, 26 per cent; and reduction of area, 53 per cent.

Approves Simplification

A simplified practice recommendation covering wire screen cloth which was evolved by the division of simplified practice, national bureau of standards, department of commerce, Washington, recently was approved at a meeting of the manufacturers of that material in New York.

J. C. McQuiston, general advertising manager, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has retired from active business and has severed his connection with the Westinghouse company.

GRAY IRON

Possesses

Valuable Engineering Properties

PREVIOUS articles of this series covered in detail the various properties of gray iron from the viewpoint of its application as an engineering material. Since it is difficult to keep in mind many of the data that have been presented, it may be well to review briefly the foregoing material, and touch upon the most essential points that make gray iron a valuable engineering material for various applications.

Gray iron as a term is generic rather specific, and covers a series of alloys of iron, carbon and silicon. These alloys are composed of various amounts of the structural components pearlite, ferrite, steadite, and graphite. The graphite, or graphitic carbon, occurs in the form of small flakes distributed throughout the matrix which consists of the other three components. The graphite flakes within themselves are comparatively noncoherent, and consequently break up the continuity of the matrix. Their effects depend on their amount, size and distribution.

In the conventional iron analysis the percentage of carbon is expressed in percentage of total carbon, combined carbon, and graphitic carbon. The total carbon consists of the graphite plus the combined carbon. The graphite occurs in flakes, and the combined carbon is contained in the cementite lamellae of the pearlite.

Modifies Strength and Rigidity

Graphite is quite effective in modifying strength and rigidity. The pearlite, containing cementite lamellae is more wear resistant than the ferrite, which is substantially free from carbon. Steadite, the formation which contains most of the phosphorus, adds somewhat to fluidity. It does not add to strength. It generally diminishes toughness and acts as an abrasive in cutting tools.

Many years ago Prof. Howe called attention to the importance of study of gray iron from the structural viewpoint and emphasized the relationship of the graphitic carbon formation to the mechanical properties of gray irons. However, it is only within recent years that further study of the influence of the graphitic carbon on the mechanical properties and investigation of the structural distribution of the graphite flakes has been undertaken. Serious attempts have been made to establish the relationships between analysis and test bar strengths, and to determine the possibility of correlation of test bar strength to castings strength. These researches proved suggestive, and many of the recent improvements in gray iron as an engineering material are based on practical applications of these findings.

Points To Essentials

UNDOUBTEDLY, many of the apparent anomalies of gray iron will be eliminated if it will be kept in mind that gray iron is a generic rather than specific term. Due to the fact that it covers a wide range of alloys, it may be expected that the proper alloy must be selected for a specific purpose to obtain the best results. While detailed information on the various properties of gray iron has been presented in previous articles of the series, a brief outline of the essential points are presented in this article.

The physical and mechanical properties of gray iron are controlled by the following causative factors: (1) Chemical composition—initial, incidental and final; (2) Structural and mechanical makeup of charge; (3) Melting process; (4) Thermal and mechanical history—furnace spout to cooled casting, and (5) Design and workmanship—(involves molding practice). Translated into terms of everyday engineering experience the outline indicates that the properties of a given iron depend upon several factors, and variation of any one of these factors will change the properties of the material.

For example, with a given analysis it is quite possible to vary the tensile strength by (a) using different amounts of steel or special pig iron in the cupola charge (b) by superheating the metal, (c) by cooling the piece either slowly or rapidly by pouring into a large or a small section, or (d) by varying the feeding by the use of various types of gates or risers. This indicates that production of uniform castings of good mechanical properties demands good technical supervision, and that similar physical properties may be obtained from irons of different analyses. This latter of course does not indicate the composition is not important, because change in analysis, other factors remaining the same, has a marked effect on the physical properties.

Carbon Is Important Factor

When other factors are constant or nearly so, the composition factor, percentage of carbon plus 0.3 times percentage of silicon, seems to bear a direct relation to the tensile properties which may be expected from a given type test bar or from a given size casting. Other conditions being equal, higher carbon and higher silicon indicate a weaker, softer iron. However, the silicon is not as pronounced in its effect on mechanical properties as is the carbon, as is suggested by Table I in the April issue of THE FOUNDRY.

Thermal history from pouring spout to finished castings in usual practice means the cooling rate. It is well known that as section size diminishes cooling rate is more rapid as indicated in Fig. 18 in the April 1, 1930 issue. It not always is practical to determine cooling rates directly. Recourse may be had to a simple mathematical calculation based on the relationship of volume to surface area as indicated in Table II in the same issue.

In many cases separate test bar data may be used successfully to predict the actual physical properties of castings of simple design. While the previously mentioned data indicate that classification according to composition and cooling rate may give close indications relative to the properties of irons made under somewhat similar foundry conditions, radical changes in melting methods, makeup of charge, etc. may cause great differences in properties of

irons of practically similar analysis.

In case of small castings it generally is possible to establish relationship between test bar and casting by relative brinell hardness or by shear tests. In larger castings it also is possible in some cases to get a tensile bar from the casting, and establish the relationship in that way. From experience in comparison of direct and indirect methods in actual shop practice, it has been found that indirect methods usually give reasonably accurate indications, and are most useful. Where discrepancies are found, the result calculated from the test bar usually is lower than the actual test on the casting—assuming of course, that the casting is sound.

Transverse Test Used

The transverse test is a commonly used foundry test and is useful to indicate the relative uniformity of the strength of the iron. However, it often has little direct engineering significance. Results are best expressed as modulus of rupture. Since the engineers' designs usually are based on tensile strengths of the material, the tensile test is of direct interest to him. While some question has been raised on the accuracy of a tensile test for gray iron, it is possible to make an accurate tensile test on regular testing equipment, and tensile tests now are being used more widely than heretofore.

As is shown by stress strain-curves, the stronger irons are more rigid, and have a higher relative modulus of elasticity which term is used to indicate the steepness in slope of the stress strain curve, and appears to be a good measure of relative rigidity.

Irons of high tensile strength usually have a minimum volume of fine, evenly-distributed graphite often with a pearlitic or sorbitic matrix. In commercial practice that usually indicates irons of low total carbon content, often though not always necessarily with combined carbon ranging from 0.50 to 0.80 per cent. The total carbon contents of irons exceeding the American Society for Testing Materials, high-test iron specification (A 88-29T) of 33,000 pounds per square inch minimum tensile usually run from 2.70 to 3.20 per cent. Silicon is kept sufficiently high to avoid a chill or mottled fracture, and low enough to avoid excessive graphitization. The old time higher strength irons usually had silicon close to 1.00 per cent for medium section castings. The tendency today in high test irons is toward higher silicon ranging 1.50 to 2.00 per cent or even more, with lower carbon, somewhat under 3 per cent. The lower-carbon, higher-silicon irons have greater uniformity in strength and hardness in different or varying sized sections. Irons of good strength (around 30,000 pounds per square inch tensile) can be produced by low carbon (3.00-3.25 per cent) with high silicon (2.50 per cent) and superheat.

Use of alloys has become quite widespread and, where intelligently used, alloys often are of decided utility. Nickel is used to obtain greater uniformity in castings of various section sizes. When nickel is used the greatest benefit is obtained when the silicon is reduced correspondingly. Chromium is a powerful carbide stabilizer and is used to impart increased strength and hardness. It often is used in conjection with nickel. Because of its potency in carbide stabilization it must be used with discretion if chill

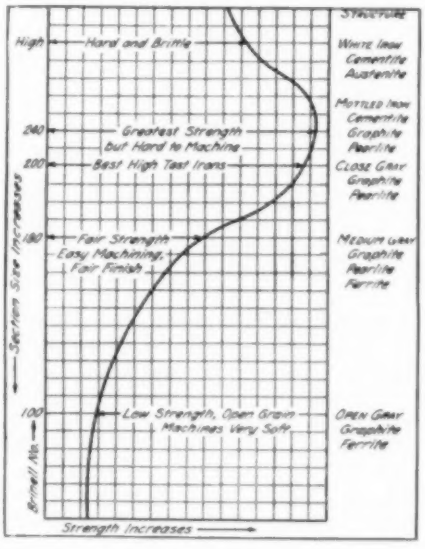


Fig. 118—Graphic Representation of Section Size, Strength, Brinell Hardness and Structural Composition

and hard spots are to be avoided. Other alloys sometimes employed are titanium, molybdenum and vanadium.

It should be emphasized that the mere addition of alloys will not make a fine high test iron out of otherwise poor material, and that it is possible to make excellent high test iron without the use of alloys. However, intelligent use of alloys may modify and possibly improve already good material.

Beside changes in the analysis, other methods have been used to enhance the good properties of gray iron; and there are many recent patents covering processes to be used for improving gray iron qualities. These methods have as their objectives not only total carbon reduction but also production of fine graphite distribution.

Some years ago Geo. K. Elliott brought out the duplexing process for melting gray iron. In this process steel was melted in an electric furnace, molten iron from the cupola added and the mixture superheated. Good carbon control was obtained and impurities such as sulphur could be held at a low point by the use of basic slag. The metal was dense, with excellent graphite distribution, and it was quite easy to obtain tensile strengths of 50,000 pounds per square inch and over. The superheating in itself densened the graphite structure, and a somewhat higher silicon content was necessary to avoid chill. Piwowarsky's study of the effects of superheat led to Hanemann propounding the theory of graphite neuclear action, which apparently explains not only the observed effects of superheat on structure but also the *inherited* characteristics from some pig irons and from steel additions. According to the theory, free graphite in the pig iron charge is not always completely dissolved in cupola melting. Flakes or portions of flakes which persist, act as neuclei and promote coarse graphite formation during the recrystallization of the metal.

Steel Affects Structure

Thus steel, being free of neuclei as charged, may have an effect over and above the change in analysis it produces. In the same way it is held that certain pig irons act differently on the mixtures than others of similar analysis but different structure. Superheat in itself is desirable, as the graphite of the charge is more completely absorbed. In Europe and in England cupolas generally are not operated nearly as hot as in the modern shops in this country (according to the comment of competent metallurgists) and devices for raising the temperature of the molten metal are not infrequent abroad.

In America electric furnace processes are used where extreme superheat is desired. However excellent material can be obtained by using high percentages of steel in the cupola, with care to get hot operation (2700 degrees Fahr. and up). Air furnaces also are used to give excellent high strength material. Other methods such as dilution processes and treatment with calcium silicide are used by some shops.

It has been found possible to produce metal with over 50,000 pounds per square inch tensile by any of the mentioned methods. However, general use of high strength material is neither necessary or desirable. Castings of such material cost more to produce and machine and therefore, should be used only where improved service justifies increase in cost. There is a wide sphere of usefulness for the ordinary types of iron which range from 25,000 to 30,000 pounds per square inch tensile, and the ordinary high-test irons with from 33,000 to 40,000 pounds per square inch tensile strength meet many severe engineering service requirements in a quite satisfactory manner.

As a general rule the strength de-

creases as section size increases, up to sections 2 or 3 inches thick. Beyond that point change in strength with increase in section usually is slow. Therefore, the engineer should take into consideration not only the strength of the test bar but also the probable strength of the section or sections in which he is interested. For example, if his casting sections are ¼ to ½-inch the metal in the casting quite likely is stronger than that in the test bar. On the other hand if metal sections are heavy, say 2 inches or more, the strength of the test bar quite likely is higher than that of the metal in the casting.

The brinell test is the most common hardness test applied to gray iron, and is one of the most practical tests for the purpose. This test measures resistance to indentation. Softer metal will take a larger impression and vice versa. Brinell members for cast iron range about 100 for the softest irons to 200 or above for the harder irons. Brinell considerably above 200, say 230, usually means chill spots (free cementite) may be found. However, some of the low-carbon, high-test irons may have brinell numbers up to 240 with no general chill effect. Either alloy additions or heat treatment may enable greater hardness to be attained without formation of chill spots.

Graphite Flakes Rigidly Held

An iron with low combined carbon (hence largely ferrite plus graphite) is likely to have a brinell number around 100. Such iron is low in tensile strength if accompanied by a large number of coarse graphite flakes. Its machinability may be good. Wear resistance of such iron usually is poor, and under ordinary foundry conditions it is likely to be open grained.

While the graphite flakes offer little resistance to indentation themselves, they are rigidly held in the matrix, and thus apparently do not lower the brinell hardness much. Pearlite offers considerable resistance to indentation and the brinell of pearlitic irons generally is around 200. Such irons, if low in total carbon content possess good strength and excellent wearing properties and can be machined at reasonable speeds. Since most commercial irons contain both pearlite and ferrite their brinells usually are between 100 and 200, and many of the good commercial irons of close grain will be found in the range 160 to 190 brinell.

Phosphorus in small amounts does not materially change the brinell values. However, the phosphorus-rich component, known as steadite, is hard and if sufficient in volume will harden the metal considerably. Chilled and mottled irons, containing free cementite generally are hard, running to over 400 brinell. Brinell hardness in small sections naturally is somewhat higher than in heavy sections.

There is a general relationship between brinell hardness and tensile strength for various irons. The value is too general to be of much use in predicting tensile from brineil. However, if irons of similar analysis are involved the relationship is much closer, and a useful correlation may be worked out. There also is a general relationship between brinell and wear resistance, and brinell and machinability. That relationship again is too general to be of much use in comparing different classes of iron but is useful for day to day checks on the same class of iron.

Consider Abrasive Hardness

Abrasive hardness is important in that it influences the machinability. The abrasiveness often can be predicted from the analysis and appearance under the microscope. Graphite in itself is soft and nonabrasive. Ferrite is relatively soft, like low-carbon steel or iron. Pearlite is harder, much like annealed 0.60 or 0.80 per cent carbon steel. Steadite is hard and abrasive. Chilled spots containing free cementite also are hard and extremely detrimental to tool life.

The shear test is useful for prospecting, and in many cases has a direct relationship to tensile test. By using the device shown in Fig. 71 in the Sept. 1, 1930 issue of THE FOUNDRY an ordinary universal testing machine can be used for loading. In most gray irons the shear is approximately equal to the tensile strength plus 9000, or conversely shear pounds per square inch minus 9000 equals tensile pounds per square inch when the device illustrated is employed.

Fatigue tests show that the endurance limit of gray iron usually is about one-half the ultimate tensile strength. Tests on range of stress indicate that from zero to maximum tension endurance limit is about one and one-half times the limit for completely reversed flexural stress. Effect of notches on endurance limit of cast iron is not as serious as it is on steel and other ductile materials. All these tests indicate that gray iron is a reliable material for service entailing exposure of vibration stresses if these stresses do not exceed a given percentage of the tensile strength of the metal. Stronger irons have higher endurance limits.

Little accurate data is available on the impact properties of gray iron. The investigations now under way under the auspices of the American Society for Testing Materials should prove interesting and valuable. While the impact resistance of gray irons is not comparable to that of more ductile material like steel, gray irons are not as brittle and fragile as some might imagine. In the absence of impact test data the probably most accurate criterion of the relative impact resistance is the area under the tensile stress strain curve. That the strong, close-grained, low-carbon irons are more shock resistant has been noted by all observers. Furthermore, although the total extension before fracture of such materials often is less than that of weaker irons, the area under the stress strain curve is greater. Steadite is a brittle component, and high phosphorus irons usually are less resistant to impact than irons of otherwise similar analysis and structure.

Tests run at subnormal temperatures indicate that the properties of gray irons are changed little if any by exposure to temperatures lower than any likely to be encountered due to weather extremes. Of course, the material continues to contract. At elevated temperatures the tensile strength, endurance limit, and hardness are little, if any changed by temperatures up to 800 degrees Fahr. The relative modulus of elasticity is lowered slightly. Data on creep tests are not available. Above 900 degrees Fahr. strength and hardness diminish rapidly.

Growth Arouses Comment

The question of growth of cast iron has aroused much comment among engineers. The recognized causes of growth are: (1) Internal corrosion; (2) Thermal gradients resulting in internal stresses; (3) Graphitization expansions; (4) Allotropic modifications, and (5) Possibility of pressure from occluded gases. Up to 800 degrees Fahr. or thereabout only the first two causes are operative. Thermal gradients are likely to be serious only when heavier sections are exposed to rapid cycles of heating and cooling or when design is poor and sections are uneven.

The probability of growth at 800 degrees Fahr. or below due to thermal gradients usually is remote. Internal corrosion is the more serious factor operative in this range. Cases have been observed where castings grew when exposed to superheated steam around 600 degrees Fahr., and as a result all applications of gray iron castings have been limited to 450 degrees Fahr. by the American Society of Mechanical Engineers boiler code. Careful study of the literature and of failures indicate that many of the troubles have been due to the selection of improper classes of iron.

Above 900 degrees Fahr. graphitization occurs and is more rapid as the temperature is increased. That weakens the metal and enhances the possibilities of growth, so the use of gray iron castings at these higher temperatures for severe services is

not encouraged. In the vicinity of 1340 degrees Fahr. the allotropic modification takes place. Growth is likely, strength is greatly lowered, and gray iron castings find few economical applications at such temperatures.

Three types of heat treatment are available for application to gray iron. These are (1) Annealing or normalizing at temperatures below the critical point, to relieve stresses and avoid warpage. A temperature often employed for this purpose is 900 degrees Fahr. (2) Annealing above the critical point to soften the casting and increase machinability. That treatment is accompanied by some loss of strength and hardness. The temperatures employed usually are 1400 degrees Fahr. or slightly above.

If the iron contains chill spots it may be necessary to employ higher temperatures ranging from 1650 to 1750 degrees Fahr. (3) Quenching (with or without subsequent tempering) to harden the casting. Quenching temperatures above 1400 degrees Fahr. (usually about 1500 degrees Fahr.) are employed. The casting must not be allowed to soak too long before quenching, or the increase in graphitization may soften the casting before the quenching. On the other hand with even higher temperature (1600 degrees Fahr. or above) more carbon normally is in solution and this often results in increased hardness. Considerable study and experimentation are necessary to determine the most satisfactory procedure for a given casting.

This is the nineteenth and concluding article of a series on the engineering properties of gray iron. The eighteenth appeared in the July 1 issue of THE FOUNDRY.

THE EDITORS.

Reviewing New Books

Worth While Literature Covering Numerous Problems Pertaining To Foundry Practice, Management, Merchandising and Research

Discusses Electroplating

Electro-Plating, by Samuel Field and A. Dudley Weill, cloth, 205 pages, 4¾ x 7¼ inches, published by Isaac Pitman & Sons, New York, and supplied by THE FOUNDRY, Cleveland, for $2.00 with postage 15 cents extra, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster.

During the past few years considerable advance has been made in the art of electroplating due to the organized research on the subject which has been carried out in the United States and Great Britain. Many of the advances only have been published in original papers, and in more extended treatises. Therefore, the authors believed that it would be advisable to review the advances in a form which would be more understandable to the practical plater. The book is divided into 16 chapters which cover the field from fundamental principles to anodic oxidation of aluminum. The first six chapters relate to fundamental principles, sources of current, the plant, properties of plating solutions, mechanical and chemical cleaning. These are followed by chapters mainly on the electrodeposition of various metals although other means are mentioned for obtaining thin coatings. Metals covered in those chapters include copper, silver, gold, nickel, zinc, cadmium, and chromium. Iron, lead tin and cobalt depositions are confined to one chapter. Depositions of alloys such as brass, bronze, etc. is covered in Chapter XV while allied processes including the anodic oxidation of aluminum are mentioned briefly in Chapter XVI.

Pearlitic Gray Irons

Edelguss, edited by G. Meyersberg, paper, 170 pages, 6 x 9 inches, published by Julius Springer, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $3.25 plus 15 cents postage, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster.

Refined castings, or the term more familiarly used in this country, high quality castings in this volume refer particularly to gray iron. It is composed of 23 articles, most of them previously published, by prominent German metallurgists and foundrymen including such names as Jungbluth, Maurer, Sipp, Bauer, Emmel, Piwowarsky, Roll, and Klingenstein. Articles by one Englishman and two Frenchmen are included.

The articles in the book, as may be expected, are devoted mainly to the discussions centering around gray irons with a pearlitic structure which have received considerable prominence in Europe and Great Britain. The book is divided into three sections. The first deals with high quality iron in general. The second section deals with improvement of gray iron through producing a pearlitic matrix, through reduction of graphite content, and through dissemination of graphite in fine particles. The third section contains articles on wear resistance, growth, heat resistance, density or solidity, electrical conductivity, and impact testing of gray iron.

Gives Statistics on Metals

Metal Statistics 1931, edited by B. E. V. Luty and N. J. Langer, cloth, 552 pages 4 x 6 inches, published by *American Metal Market*, New York, and supplied by THE FOUNDRY, Cleveland, for $2.15, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 10s postage extra.

This is the twenty-fourth edition of *Metal Statistics* which as its title indicates contains information of a statistical character on ferrous and nonferrous materials. It includes data on production, prices, etc. of iron ore, pig iron, finished and semifinished steel and steel products, coal and coke, aluminum, copper, tin, lead, etc. In addition information on population of the United States, freight car loadings, automobile production and registration, and miscellaneous data on railways is given.

Management Problems

Economic Control of Engineering and Manufacturing, by Frank L. Eidmann; 402 pages, 6 x 9 inches, cloth, published by McGraw-Hill Book Co., Inc., 370 Seventh avenue, New York and supplied by THE FOUNDRY for $4.00 plus 15c postage, in London by the Penton Publishing Co., Ltd., Caxton House, Westminster for 20s postage extra.

The book points out the problems of engineering and manufacturing whose solution depends upon economic analysis, and presents methods of approach for the industrial engineer. It is a text of the modern science of management which substitutes methods of exact calculation, as the basis of executive decision, for rule-of-thumb guesses. To determine selection between different types of equipment; to determine whether proposed changes in equipment, proceses or materials would prove economical in the long run; to determine economic sizes of stocks and lots; to determine the effects of better illumination or of organized safety work—these are a few of the many industrial problems for which the book outlines a scientific method of solution.

The author has covered his field exceptionaly well, devoting chapters to each of the important classes of management problems. The material represents the work of a number of years, and is interpreted through the author's experience in industry and as a teacher of engineering at Columbia and Princeton universities. The work should prove valuable to the engineer or executive faced with engineering problems which involve business and economic considerations.

British Foundrymen Study Merchandising Problems

TWO cities, Birmingham and Coventry, acted as hosts to the twenty-eighth conference of the Institute of British Foundrymen, which was held June 9 to 12. The Right Worshipful Lord Mayor of Birmingham, Alderman W .W. Saunders, officially opened the conference on June 10. The Lord Mayor presented the Oliver Stubbs medal to John Cameron, Cameron & Roberton, Ltd., Kirkintilloch, Scotland.

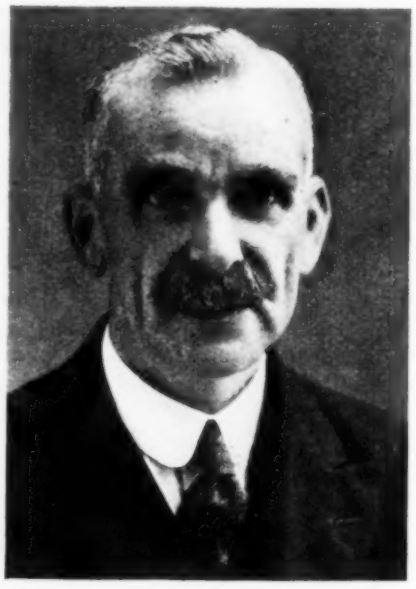
Following the annual report of the institute, F. W. Finch, one of the original founders, and for many years the honorary treasurer of the institute, gave an interesting reading of the first report of the Institute covering the year 1904, which will be included in the proceedings. The election of officers for the year 1931-32 then was held. The following members were elected unanimously to their respective offices: President, A. Harley, Daimler Co. Ltd., Coventry, senior vice-president, Victor Stobie, steel founder and engineer, Wrighton-on-Tyne; and junior vice president, C. E. Williams, Cardiff, South Wales. W. B. Lake, managing director, Lake & Elliot, Ltd., Braintree, was re-elected honorary treasurer, and F. J. Cook, R. O. Patterson and Oliver Stubbs were re-elected as trustees.

Advocates Constructive Spirit

A. Harley, in his presidential address, said that a period of depression activates the spirit of criticism, and that both the organization and the technical aspect of the industry should now be reviewed in a constructive spirit. In reviewing the activities of the institute during the past year, the speaker mentioned that a scheme for enabling students to obtain national diplomas of high technological standard in the form of a certificate, signed by the president of the Institution of Mechanical Engineers and endorsed by the president of the Institute of British Foundrymen, had been completed, and that the courses will start in the coming winter months.

In view of the fact that it is difficult for the foundry owner and operator to keep abreast of modern technical progress, the technical committee of the institute has arranged to prepare an index of technical literature which applies to developments in the foundry and associated industries allied with castings production.

It was pointed out that depression of the industry seems to have developed progress in foundry technique. With regard to the development of mechanized foundries, care should be taken not to spoil the initiative of the worker. The human element cannot be eliminated, especially in foundry work; the elimination of human effort, on the other hand, is a favorable factor. While considerable progress has been made in the technical side of the industry, the great problem is to develop a better technique of distribution.



John Cameron

Cameron & Robertson Ltd., Kirkintillock, Scotland, who was awarded the Oliver Stubbs medal of the Institute of British Foundrymen at the recent annual meeting of that association.

Eight papers were presented at the meeting. At the first technical session the American and Belgian exchange papers were discussed together. The American exchange paper, "Some Considerations and Tests for Cast Materials for High Temperature, High Pressure Service," was written by L. W. Spring, chief chemist and metallurgist, Crane Co., Chicago. This paper was summarized by V. Delport, European manager, THE FOUNDRY, The Belgian exchange paper was by H. Thyssen, Jean R. Marechal and Paul Lenarts, on "The Thermal Conductivity of Cast Iron Between 0 and 100 Degrees Cent." Discussion was opened by J. G. Pearce, director, British Cast Iron Research association, who said that a recent visit he had made to the laboratory of the Crane Co. confirmed his appreciation of the American paper, on which he had no comments to offer. Referring to the Belgian paper, Mr. Pearce said on behalf of Dr. Donaldson, who has done considerable work on the thermal conductivity of cast iron over the range of temperatures studied by the authors of the paper, that the conclusions of the Belgian authors do not agree with those of Dr. Donaldson. They do agree on the point that the smaller the graphite, the greater the conductivity, but Dr. Donaldson has found that ferrite also increases the conductivity, and in this he agrees with the Japanese investigator, Matsumoto.

Castings Are Preferable

H. C. Dews, referring to Mr. Spring's paper, emphasized the fact that the author prefers steel castings to forgings. This conclusion on the part of the author, said Mr. Dews, is a novel one, inasmuch as the testing of materials at high temperatures has only been developed to any extent in the past year or two. Mr. Dews stressed the fact that there is a likelihood that in the near future there will be a reai call for steel castings. W. T. Griffiths, said that there is some evidence supporting Mr. Spring's conclusions in the results of tests that have been made in the National physical laboratory. He indicated that American engineers seem to favor steel castings more than English engineers. H. H. Shepherd, Crane-Bennett Co. Ltd., Ipswich, said that it would be interesting to know more about the effects of corrosion on malleable iron. Professor Campion, Glasgow, confirmed the remarks made on behalf of Dr. Donaldson and A. Harley, and recommended serious study of the American paper in view of its bearing on the future of the steel casting industry.

A paper entitled "The Merchandising of Castings" was then presented by Eric N. Simons, Edgar Allen & Co., Ltd. In this paper the author stressed the necessity for foundry sales organizations to adapt themselves to modern conditions. In the discussion, V. C. Faulkner, *Foundry Trade Journal*, suggested that instead of divid-

ing the country in geographical territories, the larger firms should arrange their sales organization in such a way as to enable the various salesmen to take charge of particular industries for the whole country. A. Harley said that what is needed is to develop a type salesman who knows much more about the technical side of production than is generally the case. The salesman should be able to discuss questions of design with purchasing engineers, and should have sufficient technical knowledge and authority to advise changes of design which may reduce costs of production.

In answering these remarks, Mr. Simons mentioned that his firm combines the two ideas. The country is divided into territories over which the various salesmen travel, and, in addition, there are a number of engineers who concentrate on certain special industries and who can be called to any part of the country in an advisory capacity.

While those papers were being discussed in the main hall, another session was taking place, at which the first contribution was the French exchange paper "The Laboratory and the Foundry," by R. Arzens. In this paper a number of the duties of the foundry metallurgist are indicated, and stress is laid upon the value of his co-operation with practical executives. A contribution entitled "Sands and Sand Testing" was presented by Dr. J. G. A. Skerl, department of applied science, Sheffield. The research work effected by the author was on sands of British origin. Some of his conclusions are as follow: (1) Every sand has a definite moisture content at which it is strongest in the green-sand condition, that moisture content not being so great as that required to give the strongest sand after drying; (2) molding sands are generally most permeable when they contain the moisture content at which they are strongest in the green condition; (3) ramming increases strength and decreases permeability, while efficient milling increases strength, but does not decrease permeability; (4) the permeability of a molding sand is governed largely by the silt content; (5) the strength of a molding sand is increased about 20 times by drying; (6) the bonding material is the least refractory constituent of a molding sand; and (7) milling, improves the surface of castings.

J. Arnott, Glasgow, presented a paper entitled "Silicon as an Alloying Element," in which he reviews the following alloys: Iron-silicon, copper-silicon, silicon-bronze, aluminum-silicon, nickel-silicon, and nickel-copper-silicon. Special stress was placed upon the usefulness of silicon-bronze.

On the morning of the second day of the meeting the members were conveyed to Coventry, one of the principal automobile centers of Great Britain. The session was held in the historical St. Mary's Hall, where His Worship the Mayor of Coventry, Alderman W. H. Batchelor, gave a civic welcome. Two papers were presented at this meeting, the first by L. H. Pomeroy, managing director, Daimler Co., Ltd., on "The Relationship Between the Engineering and the Foundry Trade." The author pointed out that his own experience is a specialized one dealing particularly with the design and production of automobiles, but testimony from experience is as useful a contribution as can be made to any discussion. The author said that he had learned many lessons during nearly 8 years spent in the United States, one of which was that the applications of ferrous and nonferrous castings to automobile construction are so enormous as to merit the specialization essential to successful development of even one application. The paper was read in full and received with interest.

The meeting concluded with a paper by J. G. Pearce on "Recent Developments in Cast Iron and Foundry Practice in Great Britain." In this paper the author reviews a few contributions made by the British Cast Iron Research association to the study of cast-iron and foundry practice during the few last years. In particular the paper deals with the recommended practice of the association for the control of foundry molding sands; with improvements in cupola melting; and with some considerations arising from a study of cast-iron itself, including the development of a new series of growth—and scale-resisting irons.

During the meeting there were a number of social activities, including a reception by the Lord Mayor and Lady Mayoress of Birmingham at the Council house on the evening of June 9, and the annual banquet, held on the following evening at the Grand Hotel, Birmingham. An informal entertainment and supper was held at the Masonic Hall, Coventry, on the evening of June 11, and June 12 was devoted to a motor-coach excursion to the Cotswold country. In the afternoons of June 10 and 11, the following plants were visited: F. H. Lloyd & Co., Ltd.; W. & T. Avery, Ltd.; Henry Wiggin & Co., Ltd.; the Austin Motor Co., Ltd.; and the Midland Electric Mfg. Co., Ltd., in and around Birmingham, and the Daimler Co., Ltd.; Sterling Metals, Ltd.; Morris Motors, Ltd.; Alfred Herbert, Ltd.; and British Piston Ring Co., Ltd., in and around Coventry.

Reader's Comment

EDITOR'S NOTE—*Material Appearing Under This Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Definition Is Difficult

TO THE EDITORS:

I have read with a great deal of interest the section's serious article entitled "Gray Iron Possesses Valuable Engineering Properties" as published in the June 1 and July 1 issues of THE FOUNDRY. These articles discuss various physical and chemical properties as influencing machinability.

The second paragraph of the article contained in the June 1 issue states, "Similar to hardness, wear resistance, and certain other important properties of gray iron, machinability at present is not definable in definite or specific terms. Machinability is a complex property and is not simple to define or measure. Yet, its general significance is quite well understood—particularly in this day of high-speed production."

The writer cannot help but feel that this statement is true here after reading the discussion which follows. However, I believe, that any author is only confusing his reader when he makes such a statement and particularly when he makes others such as follows (see middle of page 56 of June 1 issue): "Extensive laboratory machining tests by H. A. Schwartz indicate machinability increases with increasing graphite content." Undoubtedly, Mr. Schwartz in his paper referred to some particular type of machinability test, as most authors of papers do with experimental data when they discuss machinability. Many similar references to easy or difficult machinability are made in the balance of the article, but there is no clue as the particular type referred to.

The writer is very much interested in the subject of machinability and for that reason deplores the use of the term machinability in such a loose way. There are many methods of indicating machinability, such as:

1. High or low power requirements as influenced by the material being cut.

2. Short or long tool life as influenced by the material being cut.

3. Short or long tool life as measured by variations in the tool for a constant material being cut.

4. A good or poor finish produced by a given tool on the metal being cut, etc., etc.

It is not a difficult matter to be specific when we are talking of mamachinability, and every effort should be made to be specific so that the reader of an article knows when such terms as "diminished" machinability are used, it is clear whether you are talking of short tool life, less

power requirement, or whatnot. Further, tool life as measured by milling or drilling does not necessarily correspond with tool life as measured by turning or broaching.

Metal cutting is so complicated in its many ramifications that it behooves us to be as clear in our writings as possible, so that there is little chance for misinterpretation of any statement.

The above comments have been made only as constructive criticism, with the hope that we may all be talking a common language which will lead to a better understanding of the subject.

O. W. Boston
Director
Department of Engineering Shops
University of Michigan,
Ann Arbor, Mich.

The authors of "Gray Iron Possesses Valuable Engineering Properties" appreciate Prof. Boston's comments, and present the following remarks for consideration.

THE EDITORS.

We agree with him that it is desirable to be as specific as possible, but that cannot be accomplished easily in an article arranged particularly for foundrymen and general readers who are more interested in the practical than in the technical side.

Prof. Boston has devoted a great deal of time to careful study of the factors influencing machinability, and to the definition of machinability in specific terms, and his excellent papers have been studied carefully. In Prof. Boston's researches, he particularly emphasizes the energy-machinability relationships, and lays little stress on the effect of abrasive microcomponents in the materials. In the opinion of the authors, based upon 12 years experience in plants operating their own foundries and machine shops and making castings ranging from 150,000 to 1 pound or less in weight, clearer knowledge of the effects of various microcomponents upon general machinability will aid the average foundryman.

It is true that abrasiveness will show up as an increase in power input as the tool edge becomes dulled. However, it does not show up in short duration tests, and there are many instances where a test such as the drill test gives misleading results. Therefore, definition of machinability as power input, or energy absorption, on given tests is not sufficiently comprehensive.

As a matter of fact in many shops energy input appears a more or less secondary consideration. Machines have the power to pull through, but it does not pay unless tool life is commensurate. For a specific example: An iron with an average tensile strength of 26,000 pounds per square inch in the test bar was used for light section castings without machining difficulties. When the tensile strength was increased, complaints were made about hard iron. However, when the irons composing the mixture were changed to increase the tensile strength to over 28,000 pounds per square inch, the average cutting speeds of the machines were increased about 40 per cent without encountering machining complaints.

In the average foundry making all sorts of castings, complaints more often arise from sand in castings, chilled edges, nonuniformity in strength, etc. In one article we attempted to emphasize those points and the necessity for cooperation between machine shop and foundry, in the hope that the suggestions would be of help to the maker of the castings and to the engineer as well.

It was felt that any discussion of tool angles, tool treatment, etc. would be beyond the scope of the articles. A review of the article in question indicates that insufficient emphasis was given to the necessity of rigid setup for machining operations, and that brief comment might have been included on the differences observed in the various types of machining operations.

In closing, it appears that Prof. Boston objects more to the things left out, than to the accuracy of the descriptions of the reasons for tool failure, etc. The authors' definition of machinability is the cost of removing metal, and the article was written to suggest to foundrymen and engineers that good machinability is dependent upon good foundry practice and metallurgy plus the proper co-operation with the shop man.

Harnischfeger Sales Corp., Milwaukee has moved its New York office from Hudson Terminal building, 50 Church street, to the Empire State building.

The Stove Is Cast in 10 Pieces Covered With Ornamental Scrolls

Early Colonial Stove Has No Grates

By H. E. Zimmerman

The stove shown in the accompanying illustration is an interesting example of cast work as turned out before the Declaration of Independence. The stove, one of the oldest in the United States, was made in 1767.

In early colonial times little was known of stoves. They were manufactured in only a few places, and their use was a luxury. The open fireplace was the ordinary source of heat both for cooking and for heating the room. The heating comforts enjoyed at the present time were undreamed of in the early eighteenth century.

The stove illustrated has been exhibited in various parts of the country and has attracted considerable attention. It is in the form of an old fashioned box-stove of the "10-plate" variety. The name comes from the fact that the stove was made up from 10 pieces.

The legs or end supports are similar to those of a sewing machine, but much heavier in section as the stove weighs approximately 500 pounds. It is 3 feet long, 32 inches high, and 18 inches wide. There is no grate in the stove, the fire being built directly on the bottom plate. The heat passes from below the oven, back of it and over the pipe.

Scrolls and designs in relief ornament the outside much in the same fashion as many stoves of today. The words, "Hereford Furnace, Thomas Mayburry, 1767" are cast on both sides. Note the wrong direction of the oblique line in the letter *N*, and also the small size of the second *R* in Mayburry, due to the lack of space. The surface finish of the stove is technically known as "pebbled." The stove is well preserved.

Gray Iron Institute Schedules Meeting

The fourth annual convention of The Gray Iron institute will be held at the West Baden Springs hotel, West Baden, Friday, Oct. 15 and 16. According to an announcement of Arthur J. Tuscany, manager, an interesting and valuable program is being developed for the meeting. In addition to reports of committees, reports of officers and the election of directors and officers, extensive discussions of the technical, merchandising and cost phases of the industry are scheduled.

The annual banquet will take place Friday evening. A golf tournament will be held on Friday afternoon and a complete program of ladies entertainment also is scheduled.

G. E. Madden, formerly with Union Steel Castings Co., Pittsburgh, will represent the Industrial Silica Corp., Youngstown, O., in the East.

BILL

By Pat Dwyer

Advises on Weights for Large Copes

"CONSIDERING the general perversity of human nature," I said to Bill the other night, "and the peculiar ideas which some people entertain on the subject of humor, I am surprised that no person has conceived the brilliant idea of sending you a fake hypothetical question on some phase of foundry practice. I can imagine the ghoulish glee with which he would pore over your serious, earnest reply. To get the full flavor he would retail the incident to some of his cronies. They would indulge in gusty laughter, slap each other violently on the back and declare that the perpetrator of the joke was a card, a wit of the first water and really should be on the stage."

"Well," said Bill, "I'll tell you. I may have been taken for a ride. I don't know, and where ignorance is bliss it's a long worm that hasn't a turn in it—or something like that. I am no mind reader and I make no pretense to omniscience. Smarter lads than I have served as the butt of a silly joke based on taking an underhand advantage of a man's confidence. I helped one time to put over a so-called joke of the kind you mention. The victim was so embarrassed at the denouncing or denouement—you take your choice, French or English—that I felt a wave of shame go over me. I was cured. If some person eventually nips me I shall regard the incident merely as the working out of poetic justice.

"In a new plant where I worked one time the chief chemist was a sincere, honest, likable lad without a trace of guile in his makeup, a Christian gentleman who assumed that his associates were as honest as himself. Had he been otherwise, probably none of the gang would have thought of the cute little scheme for having a laugh at his expense.

"He was a highly competent lad in his own line and his desk always was cluttered up with hunks of scrap and pieces of castings, some from the plant and others from outside, on which his opinion was requested. I learned a lot from listening to him dictating replies to these inquiries.

"One day while he was away on vacation, a package arrived and was opened by one of the boys in the receiving and shipping department. Lacking special instruction of any kind and basing his opinion on former experience, this bright young lad decided that the casting which he found in the package was just another one

The Boy Dashes in with the Parcel

of these things submitted for the chemist's attention. The posibility also exists that he simply wanted to get it off his hands and allow some other person to steer it to its proper destination.

"Whatever reason actuated him, the fact remains that he crept into the office, dropped the casting on Horatio's desk, remarked laconically from the corner of his mouth, 'I guess dis ting is for youse guys,' and then swaggered out and away back to the scene of his —occasional—activities.

"The casting apparently was a special type of valve body, with several vanes on the inside, a 6-inch opening at one end and a 4-inch opening at the opposite end and about 10 inches in length over all. It was machined at both ends and threaded for connection to a pipe line. So far as appearance went, it was perfect. The gang in the office naturally assumed it was destined for some use around the plant and paid no further attention to it. Incidentally, I discovered afterward that it was part of a new water cooling system at that time in process of installation.

"I intended to ask the master mechanic about it, but had no opportunity for several days and in the meantime Horatio's vacation period expired. The day before he arrived one of the gang suggested that it would be a clever idea to write a fake letter of inquiry and place it with the casting on the desk. In deference to my presumed familiarity with all kinds of casting defects I was elected with three rousing cheers to write the letter. I spent so much time in composing this deliberately equivocal epistle that I still can remember it. Also I wrote it with my left hand, so that the characters would be in keeping with composition and spelling. If I do say so myself, it was a nice piece of work:

Paradise Beech, Fla.
Toosday Night

Deer sir i am senden you today by spechul frait all charges preepaid a Casting for a Glue Straner that has me stuck. I have molded it big Side up and litle Side up and also have Tride it sideways but the Result is the Same both ends remane Open. do you think my Sand or my Iron has anything to do with this or shud i have the Pattern changed i am using a aloominum patern and my podner claims it is to lite and that is the reeson the casting is holler. I have tride nearly everything incloodin getin drunk and i wish you would send an apinyun rite away

yrs trooly
JOHN HOLTOTT

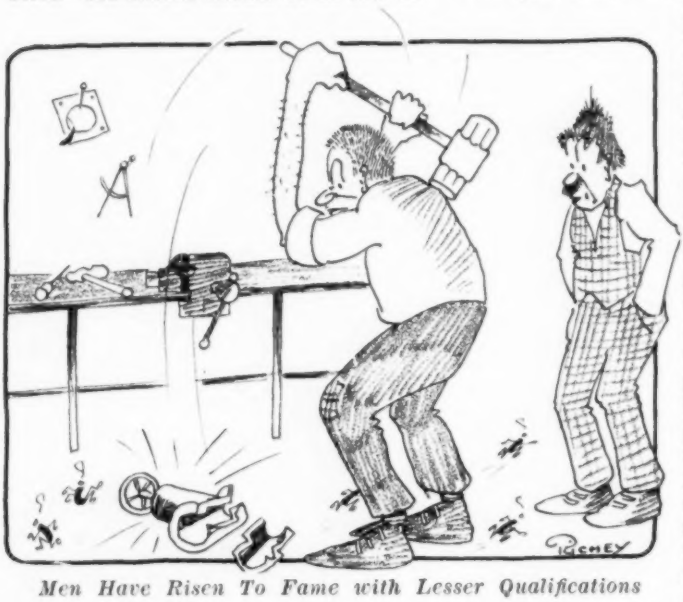
"Pawing over the collection on his desk, Horatio discovered the letter and the casting and his eyes lighted up with professional interest. He examined the casting closely, but could see nothing wrong with it. However, he was of the school which believes that what's worth doing is worth doing well. He picked up the casting and walked out of the office. The first inkling we had of how deeply he had swallowed the bait was when he returned a few minutes later with the casting all in fragments. He had taken it out to the shop, where a husky lad with a sledge hammer obligingly had knocked it to pieces for him.

"No one had foreseen this contingency. Had he discovered the hoax and taken this means to bite the biter? This doubt mercifully was set at rest when he summoned a stenographer and dictated the following letter:

Mr. John Holtott—two t's—that's right—Ah, Paradise Beach—I assume it is b-e-a-c-h although he has it b-double e-c-h—Ah, Dear Sir: A reply to your recent inquiry—Tuesday night is rather indefinite—a reply to your letter of recent date has been delayed

on account of my—change that—of the writer's absence from the city, period, paragraph.

I have examined the glue strainer which you sent and find that the only porous—or, as you say, open—area is in the top side of the heavy threaded end. This defect is due mainly to shrinkage. A number of things would help to overcome this difficulty—semicolon—the silicon should be as low as possible without making the casting too hard—semicolon again—the metal should be poured as hot as possible and if the design could be changed the section should be lightened as far as is expedient—Ah—period. In case these steps do not accomplish the result, a chill could be used and—no, change that—or, a feed head attached to this heavy section, period, yours very truly, etc.



Men Have Risen To Fame with Lesser Qualifications

"Funny? I though that one of the boys at an adjoining desk would blow a fuse before the letter was finished. The almost superhuman effort required to keep a straight face carried me back in memory a good many years to where an indignant old gentleman in the pew behind had rapped me cruelly on the head with a blackthorn stick, because forsooth of an involuntary titter which I could not suppress. If it was not for the fact that he has no business in such a place, one naturally would blame the devil for the sudden and uncontrollable bursts of merriment which seem to afflict small boys when they find themselves inside a church building.

"Just about the time the dam on hilarity was ready to burst and bury Horatio in the rushing flood of many ha-has, the master mechanic came into the office looking for his valve. By a process of trial and error, elimination, following false clues and one thing or another he finally had traced it to the den occupied by our hen.

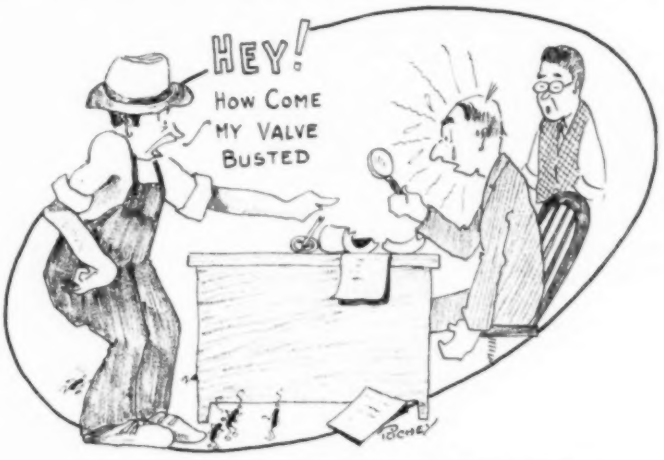
"At his first words, 'Say, did any of you birds see a valve casting around here about 10 inches long and with a lot of vanes on the inside?' Horatio began to smell a mouse, but when the eye of the M. M. fell on the broken fragments and he commenced to use language reserved for special occasions, break down jobs and thinks like that, Horatio realized his position and —as I said before—his distress was so apparent that the incident cured me.

"With your kind permission, ladies and gentlemen, Ahem—I'll take up a letter I received recently from a man who had a pan to make 10 feet 8 inches in diameter, 21 inches deep in the center and 3½ inches thick. He proposed to form the mold with a sweep in the position the pan is to asume in service, that is, with a partly spherical body of sand suspended from the cope. The casting is an acid retort and although it is not exposed directly to a fire, it is placed in the furnace in such a manner that it becomes quite hot. The customer complained that these castings crack before they have been in service a reasonable period. The foundryman proposed to pour this casting from a mixture containing 30 per cent steel and conforming to the following approximate analysis: Silicon 1.40 per cent, sulphur 0.08 per cent, phosphorus 0.25 per cent, and manganese 0.80 to 0.90 per cent. The job will be molded in the floor and as he has neither plates nor binder bars in the pit he shall have to hold the cope down with weights. He wanted to know how much weight will be required to hold the cope in place. Did I favor his idea of pop gating the mold in the center through six 1-inch gates. The casting is estimated to weigh approximately 12,000 pounds.

"The mixture he proposed pouring into the pan casting will serve satisfactorily. In fact it might be varied to a considerable extent without affecting the life of the casting. Uniformity of thickness in a casting of that kind is of more importance than the composition of the metal. The thickness, in turn, reflects a properly or an improperly made mold. The pressure against the cope is so great that the sand yields to a certain extent. If the center of the cope is not braced properly the entire center lifts and the resulting casting is much thicker than anticipated in the center. The discrepancy, of course, is not apparent to the eye and only can be discovered by actual measurement. Where the foundryman has an opportunity of viewing the cracked casting he can check up on that feature. In some instances where the casting absorbs a greater quantity of molten iron than the calculation would seem to warrant, the suspicion of the foundryman should be aroused. He should check the thickness of metal in the bottom of the casting and if he finds that it varies to any great extent from the anticipated thickness, he can make up his mind that the casting will not give satisfactory service.

"Assuming that the cope will be weighted properly, a point to be taken up presently, the anticipated sand yield may be compensated by reducing the mold cavity. The reduction naturally varies with the size and thickness of the casting. In the present instance the lower sweep may conform exactly to the contour of the drawing. The upper sweep, that is the sweep employed to form the face against which the cope is rammed, is increased ¼-inch at the deepest part of the arc and then gradually tapered off toward both extremities. The result is that when the mold is closed, the mold cavity is 3½ inches thick at the rim but only 3¼ inches in the center. The pressure exerted by the iron will equalize the thickness and the resulting casting will be uniform in cross section.

"This casting is one that might be gated according to any one of a dozen different methods without seriously affecting its appearance or usefulness, but the method he proposed undoubtedly is the best. Six 1-inch diameter pop gates spaced 18 inches apart on a 3-foot dimeter ring will distribute the metal rapidly and uniformly. However, in the event that the metal may be a little on the cool side, it is advisable to have nine gates instead of



One of Those Occasions for All the King's Horses

six. A long basin from the side of the cope conveys the metal to the circular basin supplying the ring of pop gates.

"Exact rules are available for figuring the weight of castings, also for figuring the weight required to hold molds in place. However, on large jobs it is customary to use an approximation rather than go into the extended detail calculation required to determine the exact number of pounds. For example, to find the exact weight of the casting shown in the illustration it would be necessary to calculate the cubical content in inches and multiply the result by 0.26, the weight of a cubic inch of gray cast iron. The calculation would involve finding the area of a circular plate dished to a depth of 21 inches in the center. A calculation of this kind involves sometimes a great many figures.

"For all practical purposes it is sufficient to estimate, that is to guess, how much larger the plate would be if it were flattened out. In this instance the diameter readily may be measured by taking the distance on the curved face of the sweep instead of taking it straight across the plate. Treated in this manner, the plate will be 11 feet 2 inches diameter instead of 10 feet 8 inches. The short cut rule for finding the weight of a circular cast iron plate is to square the diameter in inches, multiply the result by 0.206 and the result will be the weight of a plate 1-inch thick. If the plate is thicker or thinner, the foregoing result is multiplied by the figure showing the thickness in inches.

"Applying the foregoing rule to the casting under consideration yields the formula: 134 x 134 x 0.206 x 3.5=12,946 pounds.

"On large castings the area may be considered in terms of square feet, particularly where the dimensions show no fractional parts. The diameter is squared as in the previous instance, multiplied by 0.7854 or its approximate equivalent 0.8, then multiplied by 37.5 the weight in pounds of a cast iron plate 1-inch thick and 1-foot square. The final result is multiplied by the thickness of the casting in inches.

"Thus in this instance the formula is 11 1/6 x 11 1/6 x 0.8 x 37.5 x 3.05=12,730 pounds. It will be noted that the result approximately is the same and indicates to the experienced man that he requires at least 14,000 pounds of iron in the ladle.

"The amount of weight required to hold the cope in place is based on the displacement and is calculated by finding the area of the cope exposed in inches to the metal, multiplying that by the height of the cope also in inches and the final result by the constant 0.26. The result will be the weight in pounds.

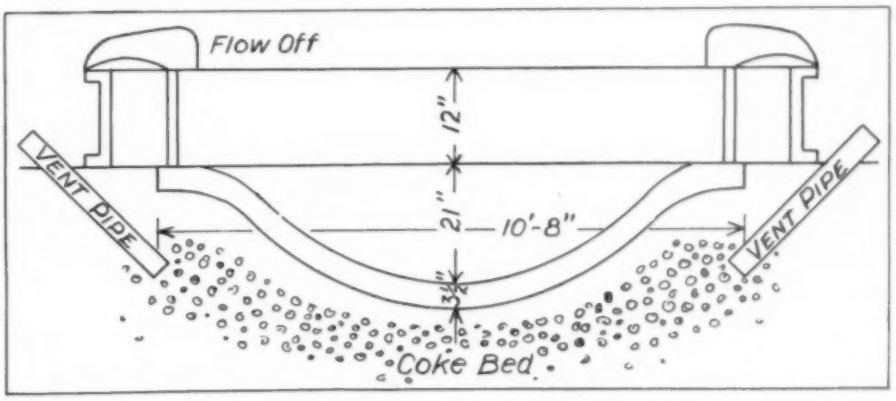
"In the present instance the area of the casting pressing on the cope is 134 x 134 x 0.8. Since the height from the top of the cope to the face of the casting is not the same all over, 12 inches at the rim and 33 inches in the center, a mean line must be established on which to base the calculation. For all practical purposes it is sufficient to assume that the curved face is flat and half its present distance from the joint line, say 11 inches. This will give a total height of 22 inches.

"The formula for finding the weight required to hold the cope in place is 134 x 134 x 0.8 x 22 x 0.26=82,166 pounds, or a little over 41 tons.

"In another method the dimensions are taken approximately in feet and shows about the same result. Instead of working from a diameter of 11 feet 2 inches, and a depth of 22 inches, a diameter of 11 feet is assumed and a depth of 2 feet. Instead of allowing 450 pounds to a cubic foot of iron, the weight is assumed arbitrarily to be 5 cubic feet to the ton. The calculation then will be: 11 x 11 x 0.8 x 2 x 0.20=42 tons.

"The cope itself will weigh in the vicinity of 15 tons leaving a balance of approximately 27 tons to be placed on the mold after it is closed. This is a minimum amount and assumes that a riser at each corner of the cope will allow the overflowing metal to escape at a height of 12 inches above the joint line of the mold.

"To support this weight it will be necessary to arrange a number of steel I-beams above the cope with the ends resting on suitable supports on the floor. After the weights have been placed in position, wedges are driven between the beams and the frame work of the cope flask. Unless the cope is exceptionally strong and rigid, it will be necessary to drive wedges between the bottoms of the beams and the tops of the cope bars."



Sectional View of Pan Mold with Coke Bed and Vent Pipes in the Bottom and with Cope in Place

Plan Fall Meeting

The first fall meeting of the Steel Founders' Society of America Inc. will be held in Chicago Thursday, Sept. 17. Other meetings scheduled include one to be held in New York on Oct. 22, the day preceding the fall meeting of the American Iron & Steel Institute.

New Jersey Founders Elect Officers

The board of directors of the New Jersey Foundrymens association met recently and elected the following officers: President, William H. Mantz, Atlas Foundry Co., Irvington, N. J.; vice president, H. L. Edinger, Barnett Foundry & Machine Co., Irvington, N. J.; treasurer, J. A. Williamson, Isbell-Porter Co., Newark, N. J.; and secretary, G. W. Hannay, Barnett Foundry & Machine Co.

H. L. Edinger was appointed chairman of the program committee, which also includes J. L. Carter, Sacks-Barlow Foundries Inc., Newark, N. J., and W. H. Mantz. C. Donath, Phoenix Brass Fittings Corp., Irvington, N. J., was appointed to the membership committee. Two additional members of the committee are to be chosen at a later meeting.

Five meetings have been arranged for the coming season, the first meeting to be held jointly with the metropolitan section of the American Society of Mechanical Engineers on the evening of Oct. 28. The remaining meeting dates are Dec. 2, Jan. 27, March 23, and May 25.

Plants To Merge

Fulton Iron Works Co., St. Louis, has been merged with the Goslin-Birmingham Mfg. Co., Birmingham, Ala., a subsidiary of the Whiting Corp., Harvey, Ill., awaiting only ratification by creditors and stockholders. The stockholders' committee and directors of the Fulton company already have approved the merger. The effect of the consolidation will be to give a diversified line of products to the Fulton company, including cranes, foundry machinery, diesel engines, power plant equipment, pumps, filters and chemical machinery. Previously its products have been confined largely to machinery for the sugar industry. Additional working capital is to be supplied by the Whiting Corp., giving balanced assets of about $4,000,000.

DAN M. AVEY
Editor

The Shakeout

FRANK G. STEINEBACH
Managing Editor

PAT DWYER
Engineering Editor

EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

NORMAN F. HINDLE
Assistant Editor

¶ Base Business on Planning

A GENERAL about to begin a battle not only must have his advance planned with precision but must have a plan to retreat ready for his forces should it be necessary to avoid disorganizing his army and passing a greater advantage to the enemy. Modern business should be handled along the same lines. Planning should be the by-word of the executive. A nationally known firm of auditors recently issued a statement that it believes that there is no simple formula for advanced business planning, but that merchants should consider the subject along four lines. The questions are of interest to the higher executives of the company, the president, treasurer, sales executive and the works manager.

THE first point of interest is, what is the market for the product? How much territory should be served? What is the competition? How much should be sold, by months, within the next year? The sales executive should decide those questions. The second point is, What are the facilities for production? Are the machinery, buildings, fixtures, land, etc., sufficient and economic? Is careful consideration being given to maintaining a proper balance in them and seeing that advantage is taken of advancement in the art, such as new machines and production methods? The works manager is interested in that question. The points that interest the treasurer are: Are finances adequate? Is more or less money needed and if so when and how much? Are finances adjusted to make a given amount money do the maximum work? The president is interested in organization problems such as: What is the capability of the organization? Is there proper team-work, a good definition of responsibilities, a practical system of responsibility within the management?

THE report states that, "the essence of business leadership is advanced planning. The cure does not lie primarily with national and international leaders or merely with big business men, but with each business man no matter what his product or position." The questions are exceedingly simple and should be understood easily by the majority of executives. However, the fact that a large auditing firm sees fit to publish them indicates that they are not well understood. Foundrymen will do well to study business conditions both in good and bad times so that they will be prepared to operate at maximum efficiency and at the lowest cost at all times.

¶ High Speed Bad News

BAD publicity has the ability to outrun facts which tend to disprove error. A case in point is the recent widespread daily newspaper attention given to the failure under test of stern post castings for five, 10,000-ton cruisers recently put in commission by the navy. Two of these cruisers were constructed in government dock yards and three by independent, privately owned shipbuilding firms of the highest reputation. According to the first newspaper reports, some of them quoting naval officers, the castings were defective.

THAT judgment should be withheld as to whether the failure of the five stern post castings so widely announced should be ascribed to casting failure or to faulty or inadequate design, is attested by later reports. It has been shown that in the attempt to lighten construction to come within the tonnage stipulations, an admittedly light design for these stern post castings was adopted. Whether this design was inadequate, of course, is still open to question.

OBVIOUSLY, the final determination of the facts in the case will require weeks of investigation. The specifications for steel castings for this service are known as class F, "special" and are subject to rigid physical and chemical requirements. Deleterious elements in the chemical analysis are held to the lowest of any known chemical requirements. The tensile strength minimum requirements include 85,000 pounds per square inch tensile and a yield point of 53,000 pounds per square inch with an elongation of 22 per cent in two inches and a reduction of area of 35 per cent. Steel of this nature *is* adequate and can be made by a great number of steel foundries in this country.

UNDER normal procedure the failure of these castings under test was front page news and was widely disseminated with the terms *faulty, failure* and *defective,* coupled with the name of steel castings. Adequate attention should be given to presenting the true facts when the inquiry is complete, in the interest of the good name of steel castings manufacturers.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

VICTOR STOBIE, formerly junior vice president of the Institute of British Foundrymen, has been elected senior vice president. Mr. Stobie has been a member of the institute since 1912 and during 1927 and 1928 was president of the Newcastle branch of the society. Born in Birmingham, England, he received his education at St. Maur's school, Paris. Later he studied electrical engineering at University college, Sheffield, and then entered the metallurgical department of the same institution under the tutorship of Professors Arnold and McWilliam. Later he established the Sheffield Annealing Works, Sheffield. Mr. Stobie established the Stobie Steel Co., Sheffield, in 1909, but sold his Sheffield interests in 1912 and established an electric steel works on the Tyne at Dunston. Mr. Stobie has been governor of the Surtes Memorial which holds examinations in foundry technique at Newcastle and Glasgow on alternate years and makes awards. He has presented papers on various technical subjects at meetings of the Iron and Steel institute, the Institute of British Foundrymen and other societies and technical groups.

C. J. McLean has been elected a member of the board of directors of Holland Furnace Co., Holland, Mich., succeeding the late C. M. McLean. Other directors have been re-elected.

David Geissinger, formerly direct factory representative in Pittsburgh for several machine tool manufacturers, has become affiliated with the Ft. Pitt Steel Casting Co., McKeesport, Pa., as special representative.

Arnold Lenz, general manager, Chevrolet Gray Iron Foundry division of General Motors Corp., Saginaw, Mich., and Mrs. Lenz sailed from New York on July 7 for a six week's European trip.

Arthur E. Painter, formerly with the Riverside Steel Casting Co., Newark, N. J., now is district sales manager at New York for Atlantic Steel Castings Co., Chester, Pa. His headquarters are at room 1908, 370 Lexington avenue, New York.

E. K. Smith, formerly metallurgist, Stockham Pipe & Fittings Co., Birmingham, Ala., has been appointed metallurgist for the Electro Metallurgical Sales Corp. Mr. Smith will be located in the Carbide & Carbon building, North Michigan avenue, Chicago.

Leon R. Clausen, president, J. J. Case Co., Racine, Wis., recently was elected president of the Racine Manufacturers association. **A. R. Callender,** president, Badger Foundry Co., was re-elected first vice president and **A. R. Janes,** president, Standard Foundry Co., was re-elected second vice president.

Allan W. Mackay has been appointed chemist in charge of the laboratory and melting for the Wright-Boag & Co. Ltd., Clyde Engineering Works, Johannesburg, South Africa. Mr. Mackay began his foundry career in Johannesburg and later came to the United States. At various times he was employed in Bridgeport, Conn.; Pittsburgh; Cleveland; Detroit and Milwaukee. Mr. Mackay is a graduate of McLain's System, Inc., Milwaukee.

Victor Stobie

J. B. Hamilton, for the past 15 months foundry foreman in the Foundry Tractorstroy, Russia, returned to Detroit, June 1. Mr. Hamilton, resumed his connection with the foundry of the Ford Motor Co., Dearborn, Mich., where he had been employed for approximately 15 years prior to his departure for Russia.

Adds New Members

Gray Iron institute, Terminal Tower building, Cleveland, has added the following foundries to its membership: Standard Castings of Cincinnati Inc., B. & O. railroad and Powers street, Cincinnati, Earl H. Rogers, president; Hartwell Iron Works, P. O. Box 105, Houston, Tex., Arthur E. Hartwell, president; Chicago Foundry Co., 2028 North Major avenue, Chicago, M. K. Wells, secretary; Mutual Foundry & Machine Co., Hemphill avenue, Atlanta, Ga., R. A. Garner, secretary; Enterprise Foundry Co., 2902 Nineteenth street, San Francisco, Charles Hoehn, president; and Hill Clutch Machine & Foundry Co., 6400 Breakwater avenue, Cleveland, Ralph Perkins, vice president.

Uniform Markings for Valves Considered

Difficulties sometimes resulting from lack of uniform markings, or entire absence of markings, on valves and fittings have prompted the National Association of Purchasing Agents to establish a committee whose object will be to develop uniform markings and promote their general adoption by manufacturers. The work is under the chairmanship of E. H. Weaver, district purchasing agent, Union Oil Co., of California, Seattle.

Award Safety Trophy

The Chattanooga, Tenn., plant of the United States Pipe & Foundry Co., recently was awarded the safety trophy given annually by the company to the plant within its organization which maintains the highest safety record throughout the year. The presentation took place at the Community hall, Memorial auditorium, June 19. Speakers on the program included A. M. Hill, Ross-Meehan Foundries, Chattanooga, and F. Woodall Johnson, managing director, Chattanooga Safety council.

Issue Abrasive Pamphlet

Division of simplified practice, bureau of standards, Washington, has available a printed pamphlet on simplified practice recommendation covering abrasive grain sizes. The recommendation establishes a table of allowable limits for sizing aluminum oxide and silicon carbide abrasives. Copies may be obtained from the superintendent of documents, government printing office, Washington, for 5 cents.

Issue Devoted to Safety

Department of labor and industry, commonwealth of Pennsylvania, has devoted the April issue of its monthly publication to a report of the Pennsylvania Safety conference. Frank J. Lanahan, Ft. Pitt Malleable Iron Co., Pittsburgh; J. J. McBride, Lycoming Mfg. Co., Williamsport, Pa.; and K. V. Wheeler, Lebanon Steel Foundry, Lebanon, Pa., were on the progrem.

OBITUARY

Harry J. Parke, for many years purchasing agent, Gisholt Machine Co., Madison, Wis., died July 6.

Sir Hugh Bell, 87, prominent in the British iron and steel industry, died in London, England, on June 28.

John Lyons Agnew, vice president, International Nickel Co. of Canada Ltd., died at his home in Copper Cliff, Ont., July 8. Mr. Agnew was born July 28, 1884, and was brought up in the mining and metallurgical atmosphere of the Pittsburgh district. He went to Canada in 1904 and became connected with the Canadian Copper Co., which later was a part of the International Nickel Co. of Canada consolidation.

Walter E. Coffin, mechanical expert, National Malleable & Steel Castings Co., Cleveland, since 1896, died June 25 at Cleveland Heights, O. Born at Dunrietta, Ind., he served the Texas & Pacific railway for ten years and then located in Cleveland. He was well known as an inventor of railroad equipment devices and had visited more than 20 countries in his business travels in conjunction with railway construction and outfitting.

Arthur Church, 72 years old, secretary, Baldwin Locomotive Works, Eddystone, Pa., died in the Pennsylvania hospital, Philadelphia,, June 26. He was born in that city and was graduated from the University of Pennsylvania in 1878 with a degree of bachelor of science. After several years in engineering work he became associated in 1886 with the Baldwin company. He was a member of various social and technical organizations.

Dr. Edward Goodrich Acheson, 75, inventor of carborundum, died July 6 in New York. Born in Washington, Pa., he was educated at Bellefonte academy and started work at 16 as timekeeper at a blast furnace at Monticello, Pa. He then held various positions and finally was employed by Thomas A. Edison at Menlo Park, N. J. In 1899 he formed the Acheson Graphite Co., and later organized numerous other companies to exploit graphite and similar products. Dr. Acheson won many honors from scientific societies, holding memberships in more than 200.

James E. Stacey, former head of the Stacey Engineering Co., which combined with the International Derrick & Equipment Co. of Columbus recently to form the International-Stacey Corp., died of heart attack on July 6 at his home in Wyoming, a suburb of Cincinnati. Mr. Stacey had been active in the manufacturing and public utilities field for more than 50 years after becoming connected with the Stacey Mfg. Co., which was founded by his father.

DIRECTORY OF FOUNDRY ASSOCIATIONS

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, Herbert H. Klein, Pennsylvania Foundry Supply Co., 310 Congress street, Boston. Meetings the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, L. E. Gilmore, Crane Co., Chicago; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Connecticut Nonferrous Foundrymen's Association

President, C. H. Blanchard, Reading Steel Casting Co., Pratt & Cady division, Hartford, Conn.; secretary, C. D. Elliott, Wilcox, Crittenden Co. Inc., Middletown, Conn. Meetings held the second Monday of each month at place to be named. Recent meetings have been held at Hotel Garde, New Haven, Conn.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, Neil I. McArthur, Great Lakes Foundry Sand Co., 2100 Penobscott building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Ft. Shelby Hotel.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; manager, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

New Jersey Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting dates: Oct. 28, Dec. 2, Jan. 27, 1932, March 23, 1932, May 25, 1932.

New England Foundrymen's Association

President, Luther J. Anthony, Glenwood Range Co., Taunton, Mass.; secretary, Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings held the second Wednesday of each month excepting July and August at the Engineers club, 2 Commonwealth avenue, Boston. Outings usually are held in the months mentioned.

Ohio Foundries Association Inc.

President, A. H. Kramer, Advance Foundry Co., Dayton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, H. F. Siefert, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meetings on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, E. A. Gullberg, Union Malleable Iron Works, East Moline, Ill.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, W. C. Raithel, Century Electric Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, W. H. Worrilow, Lebanon Steel Foundry, Lebanon, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. P. Jensen, Prescott Co., 1 West Lander street, Seattle; secretary, Edward C. Gustin, 3716 Grayson street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on second Wednesday of each month at Hotel Schroeder, Milwaukee.

Cooler Is Built in Five Different Models

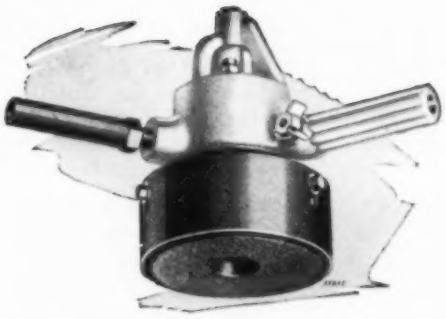
Frigidaire Corp., Dayton, O., recently has placed on the market a new electrically operated water cooler equipped with a porcelain lined food and beverage compartment shown in the accompanying illustration. The new unit is designed especially for small organizations and private offices. It is finished in metallic lacquer and is equipped with chromium plated hardware. The new line is made in five models, three of which are of the individual type for use in offices and small shops and the other two are designed to meet the require-

The Unit Is Designed for Offices and Small Shops

ments of the general office and small industrial plant. In addition, the company builds two, tank type coolers for large factories, the larger of which will provide cold drinking water for 250 people. The individual coolers are equipped with one-fifth horsepower motors and are adapted for use of either bottled or piped water.

Grinder Is Air Driven

A new grinder and sander of the multi-vane type has been added to the line of air tools made by the Ingersoll-Rand Co., 11 Broadway, New York. This tool is a lightweight machine which is suitable for grinding, sanding, polishing, and wire brushing operations. It is claimed to be a powerful, smooth running and correctly balanced tool. The machine is built with two handles so that the operator readily can hold it at right angles to the working surface. One of the handles may be removed to facilitate working in close quarters. The second handle acts as the air inlet and



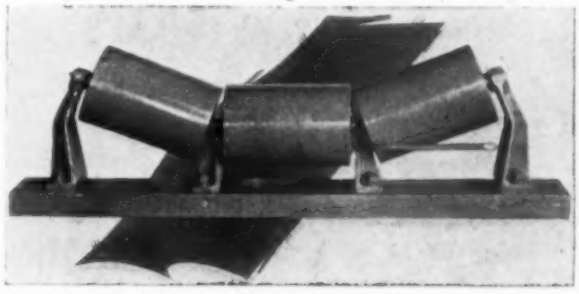
Two Handles on the Machine Facilitate Working at Right Angles

contains a thumb-controlled throttle valve. Standard free speed is 4600 revolutions per minute but units can be supplied for higher or lower speeds. Overspeed is prevented by a governor. The tool weighs 10¾ pounds without the adjustable guard for grinding wheels. It has a bare overall length of 9¼ inches.

Idlers Are Equipped with Roller Bearings

A series of belt troughing and return idlers equipped with roller bearings manufactured by the Timken Roller Bearing Co., Canton, O., recently has been introduced by the C. O. Bartlett & Snow Co., Cleveland. The pulleys for the troughing conveyor are mounted on four brackets which in turn are mounted on inverted steel channel. This method provides a continuous support across the belt except a ¼-inch gap between pulleys. Open tops on the bracket permit any pulley to be removed without disturbing the bracket or the adjacent pulley. The single pulley of the return idler is similar to the pulleys of the troughing idler but the brackets are of the hanging type.

Provision is made for renewing the pulley shells without destroying the pulley ends. The pulley ends are made of cast iron and the shell is



Provision Is Made for Renewing Pulley Shells Without Destroying the Pulley Ends. Pulley Ends Are Made of Cast Iron and the Shell Is of Seamless Steel Tubing, 6 Inches in Diameter and ¼-inch Thick

manufactured from seamless steel tubing ¼-inch thick and 6 inches in diameter. A single grease fitting serves to lubricate the two bearings of each pulley in the troughing idler. The longer return pulley has a fitting for lubrication at each end. A central tube prevents the escape of grease to the interior of the pulley. The flow of grease is toward the outside and the bearings are flushed as they are greased in this manner. Bearings are protected with 4-pass metal labyrinth seals.

The new type troughing and return idlers are made in nine sizes for belt widths from 18 to 60 inches.

Separator Exerts High Magnetic Pull

Magnetic Mfg. Co., Milwaukee, has placed on the market an induction, roll type, magnetic separator which is claimed to give high magnetic intensity with low power cost. The maker claims that the machine shown in the accompanying illustration will separate such materials as feldspar,

The Machine Is Built for the Separation of Materials Not Generally Placed in the Magnetic Class

dolomite, gypsum, rock, glass, abrasives etc. since it is said that those materials are subject to magnetic separation in high intensity fields.

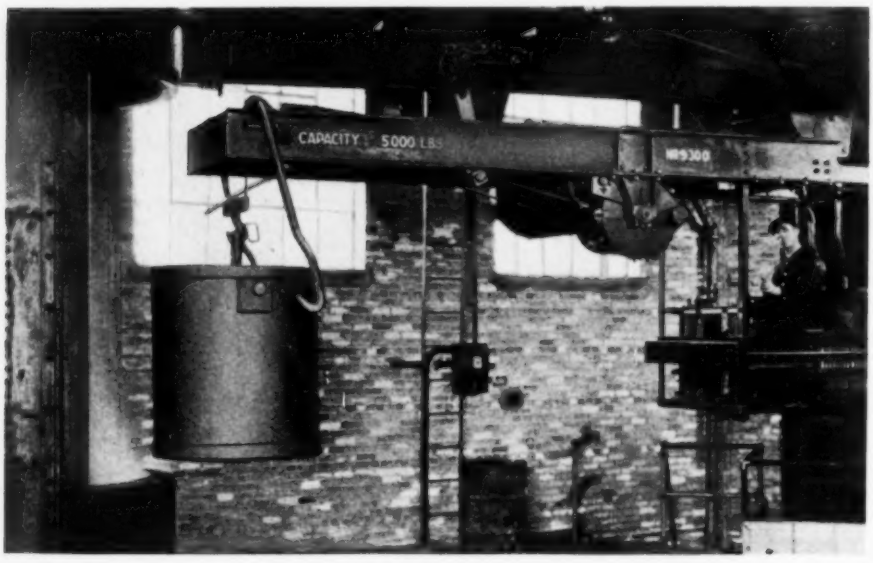
The separator is built to give three or more stages of magnetic separation according to the requirements of the material being treated. Capacities range up to 10 tons per hour. No conveyor belts or pulleys are required. Continuous separation is accomplished by gravity feed.

Ellsworth L. Mills has been elected vice president of the Bastian-Blessing Co., 240 W. Ontario street, Chicago. Mr. Mills, formerly sales manager, will continue in charge of sales.

Cupola Charging Unit Has New Features

Harnischfeger Corp., Milwaukee, has developed a cupola charging hoist which is designed in such a manner that no part of the hoist or bucket is inside the cupola longer than the time required to dump the load. That feature is claimed to minimize damage to equipment by exposure to excessive heat.

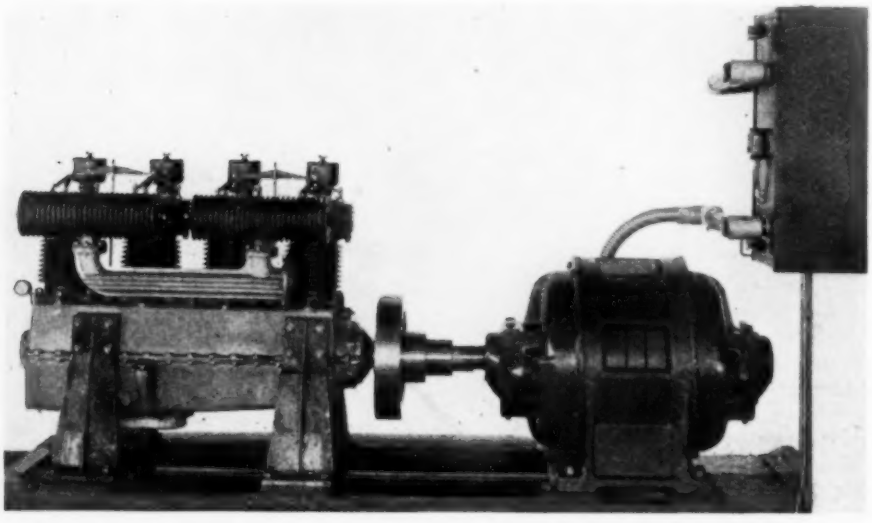
One drum is used on the new charging device and the cable from the drum is attached to the cone-shaped bottom of the bucket. The bucket is held by that cable as the hoist travels to the cupola. As the charging machine begins to enter the door, a lever which controls two hooks, shown at the left in the accompanying illustration, comes in contact with a baffle plate on the underside of the runway beam. That lever throws the hooks into position under the trunions on the bucket. When the bucket is lowered, the hooks engage the trunions and the cable lowers the drop bottom which discharges the load into the cupola. Speed of dumping the load is controllable by the operator and there is no possibility of the cone-shaped bottom becoming disengaged since a safety hook always holds it securely in place.



Hooks Hold the Bucket in Place While the Bottom Is Lowered

Compressors Are Small

Davey Compressor Co. Inc., Kent, O., is manufacturing a line of compressors which are applicable to the needs of small foundries. One unit, shown in the accompanying illustration displaces 142 cubic feet per minute and is the smallest of the class. Other units displace 240 to 320 cubic feet per minute respectively. The machines are entirely automatic, air-cooled and electrically operated.



This Compressor Displaces **142** *Cubic Feet of Air Per Minute*

Combines Tumbling and Pickling Operations

Bronze Die Casting Co., 1836 North Franklin street, Pittsburgh, recently has placed on the market a new unit which combines tumbling and pickling operations. The accompanying illustration shows the unit consisting of a series of wheels mounted on a drive shaft which is driven through a reduction gearing by an electric motor. The wheels are stationary on the shaft. A series of endless acid resisting chains roll over the wheels and carry the perforated acid resisting barrel containing the castings. As the shaft revolves, the chain moves and rolls the barrel, thus giving the tumbling effect. The barrel is located in the acid bath. Chains, wheels, and barrel are made of a special acid resisting metal developed by the Bronze Die Casting Co.

The Barrel Containing the Castings Is Mounted on the Chains

The unit operates in the following manner: The perforated barrel is lowered onto the chains in the tank and the motor operating through the speed reducer revolves the shaft and the wheels at a rate of ½ revolution per minute. As the chain moves forward, the barrel rolls over and over on the chains where it is held in position by sheaves around the circumference of the barrel. The pickling tank is constructed either of concrete or of wood. The shaft fastener is bolted with acid resisting bolts.

Engineering research circular No. 5 published by the department of engineering research, University of Michigan, Ann Arbor, Mich., describes the facilities and equipment that the department has available for research service for industry. A list of problems on which the department has conducted research also is given.

Trade Trends in Tabloid

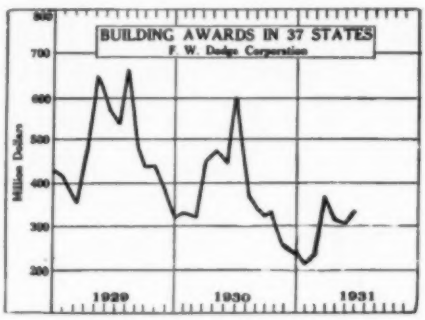
SEASONAL influences continued to affect industrial activity in general during July, forcing production in numerous lines to lower levels. In the face of this condition, business sentiment appears remarkably strong.

—T—T—

As is usual during the summer months, foundry operations have slackened slightly. Nevertheless, activity among foundries is exceedingly spotty, and numerous plants widely scattered are enjoying a fair business.

—T—T—

Automobile production eased off slightly in July according to esti-



mates. Increased production of a new model recently introduced in the low priced field helped to offset declines of other makers.

—T—T—

Revenue freight car loadings for the week ended July 4, totaled 667,879 cars, a decline of 91,411 cars over the preceding week. The decline over the holiday was not as pronounced as usual this year.

—T—T—

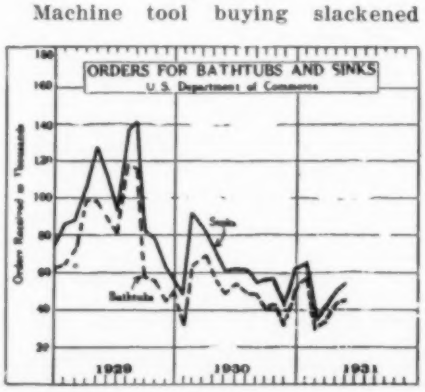
Preliminary reports show that production of gray iron castings by members of the Gray Iron institute in June was 53.1 per cent of capacity, compared with 60.7 per cent in May.

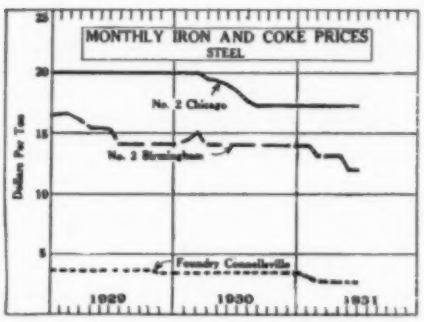
—T—T—

Orders for domestic freight cars in June called for 1910 units, the third largest total of the year. Car buying was light the first part of July.

—T—T—

Machine tool buying slackened





again in June, bringing the first break of the year to the three month's moving average.

—T—T—

Orders for foundry equipment continued the decline of the past three months, according to the Foundry Equipment Manufacturers association. Index of orders for June was 40.9 compared with 54.02 in May. Index of unfilled orders was 70.1 against 123.8 in May.

—T—T—

Contrary to the usual trend, building awards in June showed a slight gain over the previous month. Awards in June totaled $331,879,700 compared with $306,079,100 in May and $600,573,400 in June, 1930, according to the F. W. Dodge Corp.

—T—T—

While a few jobbing shops in the St. Louis district have increased operations during the past 30 days, in general the business situation remains about the same. Implement

RAW MATERIAL PRICES
July 21, 1931

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	12.00 to 13.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	17.50
Malleable, Buffalo	17.50
Coke	
Connellsville beehive coke	$3.25 to 4.50
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$11.00 to 11.50
Heavy melting steel, Pitts	10.00 to 11.00
Heavy melting steel, Chicago	8.50 to 9.00
Stove plate, Buffalo	7.75 to 8.00
Stove plate, Chicago	7.00 to 7.50
No. 1 cast, New York	7.00 to 7.50
No. 1 cast, Chicago	8.75 to 9.25
No. 1 cast, Philadelphia	11.50 to 12.50
No. 1 cast, Pittsburgh	10.00 to 10.50
No. 1 cast, Birmingham	10.00 to 11.00
Car wheels, iron, Pittsburgh	10.50 to 11.00
Car wheels, iron, Chicago	10.00 to 10.50
Railroad malleable, Chicago	8.50 to 9.00
Agricultural mal., Chicago	8.25 to 8.75
Malleable, Buffalo	10.00 to 10.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	7.75
Straits tin	25.00
Aluminum, No. 12, producers	22.00
Aluminum, No. 12, remelt	9.00 to 10.50
Lead, New York	4.40
Antimony, New York	6.75
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	3.90

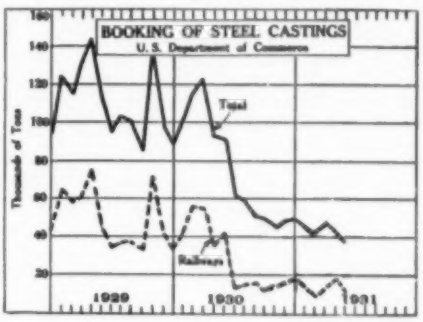
and stove manufacturers feel that low prices on farm products will hinder their business.

—T—T—

Aluminum foundries in the Chicago district are working at a fair rate considering general business conditions, with operations averaging 2 to 3 days a week. Brass foundries are working at about 25 per cent of capacity. Several gray iron foundries in Western Michigan making automotive castings were closed the last half of July.

—T—T—

Production of pig iron in June reached the low point of the year, with a daily average output of 54,-



599 tons, according to *Steel*. Production of merchant iron was 349,200 tons in June compared with 392,630 in May.

—T—T—

Deliveries of brass and bronze ingots and billets by members of the Nonferrous Ingot Metal institute declined 836 tons in June to a total of 3584 tons.

—T—T—

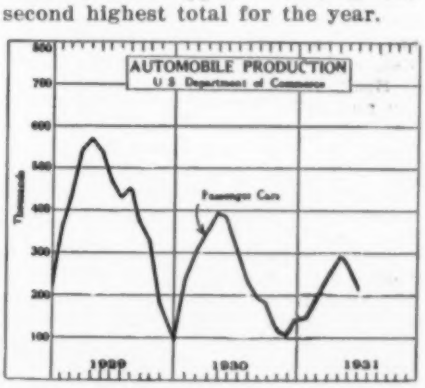
Reports of contemplated increases in foundry operations are noted in the New England district.

—T—T—

Closing of several automotive foundries for summer vacations and inventories has lowered the operating rate in the Cleveland district.

—T—T—

Unfilled orders for railroad locomotives for domestic shipment in June totaled 84 units, of which 54 were electric types. This is the second highest total for the year.



What the Foundries Are Doing

Reflecting the Activities of Gray Iron, Malleable, Steel and Brass Shops

American Steel Foundries, Alliance, Ohio, has resumed full operations after being idle the greater part of June.

Wheel foundry department of the Lenoir City Car Works, Lenoir City, Tenn., recently resumed operations.

Plant of the Modern Pattern Co., Sandusky, O., recently was damaged by fire, loss being estimated at $15,000.

Illinois Foundry & Machine Co., 216 Centerville avenue, Belleville, Ill., has discontinued business.

Hatboro Foundry Co. (Robert & Mander Stove Co.), Hatboro, Pa., is working five days each week at 90 per cent of capacity.

Olney Foundry Co., 180 West Buncannon avenue, Philadelphia, reports that present business has shown a 20 per cent improvement over May.

The equipment of the Cramp Brass & Iron Foundry Co., Richmond and North streets, Philadelphia, is being moved to the Baldwin Locomotive Works, Eddystone, Pa.

Philadelphia Hardware & Malleable Iron Works, State Road and Shelmire (Tacony), Philadelphia, Pa., reports a steady improvement in business since March 15.

American Manganese Bronze Co., Holmesburg, Philadelphia, Pa., reports good business thus far in 1931. The plant is working full time, five days a week.

Fremont Foundry Co., Sixth and Dickison, Fremont, O., resumed operation on July 6 after being closed for the usual midsummer suspension of ten days.

Herman L. Brown recently was appointed receiver for the Sterlite Foundry & Mfg. Co., Auburn, Ind. Col. A. L. Kuhlman will continue to conduct the business during the receivership.

Kinite Corp., S. E. Spartz manager, Milwaukee, is establishing a foundry at Fairmont, W. Va., for the production of molds for glass bottles. The company will employ 30.

Name of the Buffalo Steam Pump Co., Oliver and East avenue, North Tonawanda, N. Y., has been changed to Buffalo Pump, Inc., with office at 490 Broadway, Buffalo.

Lynchburg Foundry Co., Anniston, Ala., suffered a $10,000 fire damage to its finishing department recently. The company plans to rebuild the damaged section.

American Pattern & Mfg. Co., Sattley building, Racine, Wis., has been incorporated to manufacture patterns, tools, dies, etc. The incorporators are Einer J. Beck, Ester E. Beck, Hans A. Nelson and Tillie Nelson.

National Foundry Inc., Whitman, Mass., has been organized by W. A. Luce, Whitman, and G. J. Clark, West Hanover, Mass., to operate a plant for the manufacture of iron, steel and other metal castings.

Jenkins Machine Co., Sheboygan Falls, Wis., filed a bankruptcy petition in federal court in Milwaukee on July 9. Mark Hoeper, who has been in charge of the plant for the past several months, was appointed receiver.

Illinois Malleable Iron Co., 1801 Diversey boulevard, Chicago, has transferred the property at the southwest corner of Wellington and Ashland avenues to the Chicago Title & Trust Co. as trustee.

American Foundry Co., 1535 Naomi street, Indianapolis, recently received a contract for 20,000 motor blocks from the Chrysler Motor Corp., and has reemployed approximately 300 men who have not worked for several weeks. Blaine H. Miller is president.

A voluntary petition in bankruptcy was filed for the Fisher Co., Marysville, O. While the company will be operated by the receiver at present, the officials of the company plan to reorganize and continue operation in the future. Herbert C. Kent, Delaware, O., is receiver.

Service Foundry, Inc., South Peters and Erato streets, New Orleans, La., was damaged by fire recently to the extent of $5000. The company has let contract to T. A. Pittman Inc., Canal building, for construction of a new plant unit.

Ford Motor Co., Fordson, Mich., proposes construction of a foundry unit and other structures in connection with a development at Gladstone, Mich., site for which has been acquired. Equipment will be required. Cost is estimated at $250,000.

Schill Bros. Plow Co., Crestline, O., has been reorganized and has elected F. P. Hayes, Crestline, president; E. B. Beall, Galion, vice president; E. T. Remy, Crestline, secretary. O. F. Kime, Dr. J. W. McCallum and the officers form the board of directors.

St. Marys Foundry Co., St. Marys, O., has plans under way for a $54,000 improvement to its plant. The additions include one 150 feet long and 40 feet wide and a second 120 feet long and 30 feet wide which will double the present capacity of the plant. It is expected that the building will be started in September or October.

New Trade Publications

SLING CHAINS——Newhall Chain & Iron Co., 9-15 Park Place, New York, has issued a folder illustrating and describing several styles of heavy-duty, wrought iron, sling chains. Hooks, swivels, and fittings also are illustrated.

CRANE BRAKING——Dynamic braking, bridge-top control for crane bridge motions is described in a recent folder from the Electric Controller & Mfg. Co., Cleveland. Necessity of the device in preventing costly crane accidents is stressed and advantages of the equipment are outlined.

MOLDING SAND—A recent booklet from the Ayers Mineral Co., Zanesville, O., points out the advantages of the certified molding sands produced by the company. The advantages of careful sand control are discussed and workings at various sand deposits of the company are illustrated.

FOUNDRY LAYOUTS—A novel folder recently issued by Austin Co., Cleveland, contrasts the losing side with the winning side in the effort for foundry profits. The gate to foundry profits is represented as separating the well ordered and equipped foundry from the haphazard, inefficient foundry. Services of the company are recommended.

ABRASIVE WHEELS—Polishing applications of a cushion abrasive wheel using coated abrasive bands are outlined in an illustrated folder recently issued by C. B. Hunt & Son, Salem, O. The method of attaching the coated abrasive band to the wheel is illustrated and its value in finishing castings and wood or metal patterns is pointed out. Specifications and prices of standard sizes are given.

ELECTRIC FURNACES—Pot-type electric furnaces designed for heat treating with elimination of surface scale are described in a recent, illustrated bulletin from Ryan, Scully & Co., Philadelphia. Construction, size, and electrical specifications are outlined. Electric-furnace, metallic resistors made by the same company are described in another bulletin and reasons for superiority pointed out.

SAND TESTING—Equipment manufactured and distributed by Harry W. Dietert Co., 676 West Grand boulevard, Detroit, for foundry sand testing and control, is described in catalog No. 102 recently issued. A complete line of testing equipment is shown, a price list is included, and a section of the publication is devoted to assembly and maintenance. Valuable, practical and technical data are presented in the final section of the catalog.

TURBO BLOWERS — Centrifugal blowers and compressors are described in a recent, illustrated catalog from Ingersoll-Rand Co., 11 Broadway, New York. Blowers are available for from 1 to 40 pounds gage discharge pressure in sizes ranging from 3000 to 100,000 cubic feet per minute; compressors up to 110 pounds pressure from 8000 to 10,000 cubic feet. Typical applications including foundry cupola service are listed.

MATERIAL HANDLING — Current folder from Cleveland Electric Tramrail, division of Cleveland Crane & Engineering Co., Wickliffe, O., illustrates methods of cutting foundry costs by installing modern handling equipment. Methods are listed and typical applications illustrated. A second folder illustrates applications of the tramrail handling methods in the automotive industry, and a third for moving material and product through ovens and dryers.